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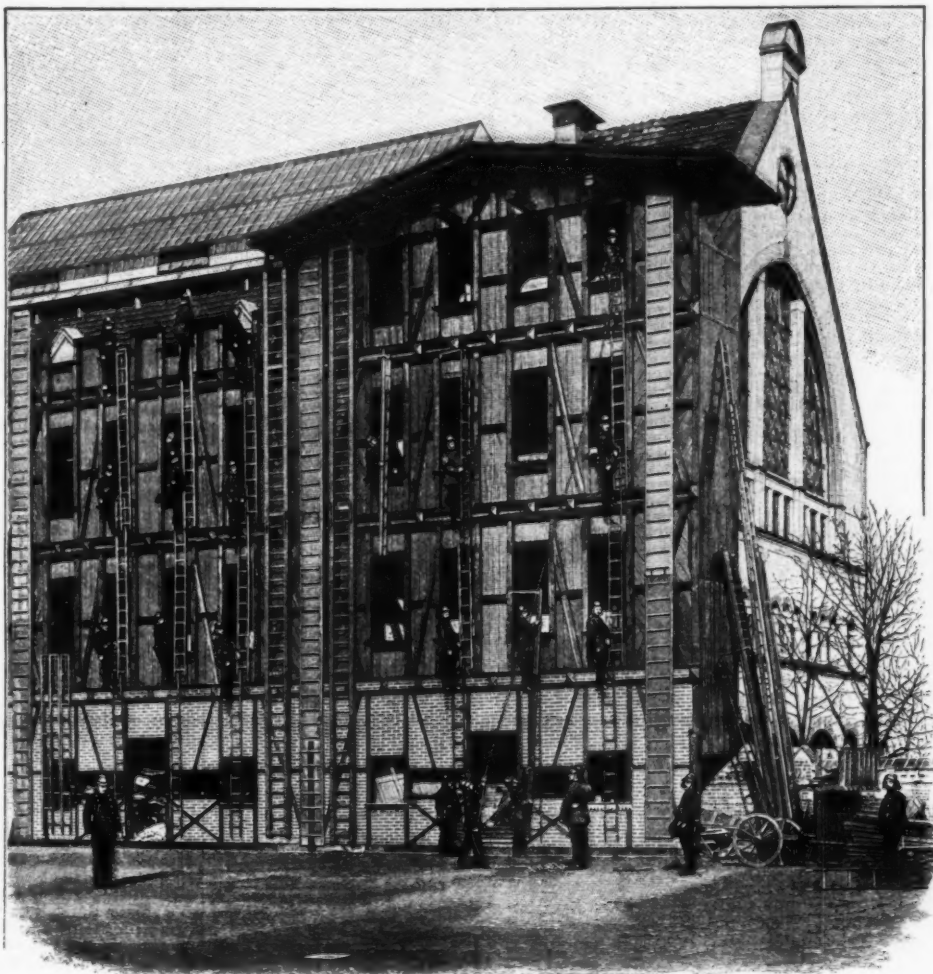
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A DAY IN THE CHIEF FIRE "WATCH" OF BERLIN.

LET us suppose it to be five o'clock in the morning, and the first rays of the sun streaming through the high windows of the sleeping room, across the blue checked bedspreads and over the bronzed faces of the sleeping men. But they do not stir, for they are tired out by their recent struggles with the element of destruction. The clock strikes half past five and all spring out of their beds, fully dressed, even to coats and boots. Soon all are bustling about. The sleeping room, living room, workshops, and engine room must be swept and cleaned, clothing beaten, the apparatus polished, the exercising room swept and sprinkled; in short, all preparations for the day's work must be made. Finally the men go to the bath rooms to make their toilets.

At half past six a whistle summons all to roll call, and the entire force goes in military order to the assembly room to receive the orders of the company chief. A special position, as that of a sapper, orderly, fireman, etc., is assigned to each man for that particular day. Each one of those who are ordered to serve on the fire apparatus receives a number which indicates which vehicle—the engine, water cart, or the wagon for the men—he is to go on, and each number corresponds to a certain definite task, such as harnessing the horses, carrying the torch, handling the ladders, attacking the fire with the hose, etc. Every part of the work to be performed,



PRACTICE HOUSE.

from the instant the alarm is given until the horses have been put back in their stalls, is assigned in this way.

At the roll call the new force goes on duty for forty-eight hours, and the crew which then goes off duty spends the next twenty-four at home, being entirely free during that time. The rooms occupied by the chief of the department, the brandinspektor (fire inspector), and brandmeister (fire master) while on duty are in the station or "watch building." The other stations are also provided with rooms for officers. There are, altogether, five "company watches," each of which has two sets of apparatus (or "extinguishing trains," Löschzüge, as they are called in Berlin) and ten "train watches" with one set of apparatus. The "company watches" are always under a brandinspektor and the "train watches" under a brandmeister.

While on duty the men of the watch are always ready for an alarm.

But, just now, there is nothing to disturb the peace of the house. The crew is working under direction of the brandmeister. The engine and wagons are being washed and polished, the horses curried and brushed, but everything has a peaceful, one might almost say a serene aspect, and even the hazardous drill on the practice house and tower seem to be purely for the pleasure or for the healthful exercise of the force.

The work seems a little more serious, however, when the great mechanical ladders, mounted on heavy wagons, are rolled out and raised to a height of about



STEAM ENGINE AND TENDER.



HAND ENGINE, WATER CART, AND WAGON FOR MEN.

80 feet. Many have climbed these ladders into terrible danger, and many have been brought back on stretchers.

The mechanical ladder, with the help of which the highest stories of Berlin business and dwelling houses can be reached, is provided with a turntable and driving gear, by means of which it can be extended to any desired place and given any desired inclination. The ladders generally used by the fire department in scaling a burning house are about 16 feet long, and are hooked into the window openings, so that the men can climb from story to story. In our engraving of the "Practice House" these ladders are shown in use.

In cases of great danger, people in the upper stories are saved by means of the "rescue belt" or "rescue sack," which is fastened to an endless rope that passes over a hook and can be drawn up and down by means of a pulley. The velocity of this apparatus can be regulated by a brake mechanism, which prevents a sudden fall. But often there is not time to arrange this apparatus, although it requires only a few minutes, and then there is nothing left but to use the sailcloth. This is a piece of sail cloth, about 14 yards square, which is provided with handles, so that it can be stretched and held taut by twenty to twenty-five men, in order that people can jump into it. But such a jump is never taken until it seems the lesser evil, and often results in serious injuries. While watching the interesting climbing and rescuing drill, a hand engine and a steam engine, with the accompanying vehicles, dash up, and we almost regret that the practice tower is not in flames, so that we can write a thrilling account of the fire.

Now, a word about the smoke helmet and other apparatus for protection from smoke which enable the firemen to go where the heat is very intense and the smoke is thick, almost into the fire itself. English linen, which is water and air tight, is much used for these suits, to which air is supplied by means of rubber tubing connected with an air pump. To this outfit belongs a peculiar helmet, provided with a tube connected with a device for occasionally wetting the entire suit. But this apparatus is not as generally used as the new "smoke cap," which has proved most useful in saving endangered human lives. It consists of a metal or leather helmet that incloses the entire head, being provided with a slit for the eyes, and channels opening in front of the face, through which a strong current of air is supplied that prevents the entrance of smoke into the helmet. But the use of the smoke helmet is not always advisable, for, under certain circumstances, as in fires in chemical and some other works, gases are generated which are so poisonous that the inhalation of even a small quantity would prove fatal. In such cases the Honig breathing apparatus is used, which closes the nose tightly and is provided with a tube that ends just in front of the mouth, so that the fireman breathes air supplied from outside of the building.

All apparatus, tools, articles of clothing, etc., are repaired—and, to a certain extent, new ones made—in the workshops; but all repairs of the hose are made at the hose works of the division, for even the slightest damage must be attended to with the greatest promptness and cannot be trusted to slow hand workers. Here we find shops for cabinet makers, locksmiths, saddlers, tailors, and shoemakers, which are fully equipped.

But now it is noon and dinner is brought to the firemen by their families in large baskets, the contents of which are placed on the tables in the living room and enjoyed by the men, who arrange themselves in groups. After dinner, the men go to the sleeping room for an hour's rest, which is necessary for these hard workers. In the meantime we will visit the telegraph office, so as to try to learn something of this highly important factor of the department; but that is not an easy matter, for, with the constant buzzing, humming, and clicking of the contact springs, wheels, etc., of the innumerable apparatus, it is not easy to make one's self understood by the officials, and, to make matters worse, the two telephone apparatus in the room are in constant use.

But we understand, finally, how a fire alarm is given. The Berlin fire alarm apparatus is scattered over the entire city, and anyone, even a child, can give the alarm by manipulation of a very simple mechanism. These apparatus, which are made by Siemens & Halske, are so arranged that by pulling a handle the electric circuit in which they are located is interrupted, and each interruption causes a character to be made by the Morse apparatus in the two nearest fire stations (watches).

These characters are repeated twelve times and then the apparatus is thrown out. The circuit breakers of the various alarms are different; that is, they cause interruptions of larger or shorter duration and cause different characters to be made. In this way it is easy to tell where the alarm comes from.

Now the telegraph operator sets the entire alarm mechanism of the building in operation, notes the number of the alarm box, and immediately notifies the other stations or watches, so that they shall be all ready for an alarm. From each of the stations that received the direct alarm an officer starts with his corps for the place from which the alarm came, which is soon reached. A man jumps down from the cart and inquires of the person who sent in the alarm where the fire is, and then the apparatus rushes on to the place designated. An alarm can also be given from a police or other station by a simple arrangement of telegraphic keys or by telephone.

If the alarm "large fire" is given, there is bustle and noise in every part of the building in an instant. The men rush from the living room, the doors of the engine room fly open, the horses are driven from their stalls, orders are given, and, a minute later, the apparatus is out of the house. First goes the hand engine, the wagon with the men, and the water cart, then the tender and the steam engine, with a crew of two stokers, eight upper firemen, and thirty-eight men. Then the great machine ladder rolls heavily after. The fire is reached in a few minutes. A deafening sounding of bells announces the approach of the apparatus, which breaks through the crowd and reaches the space in front of the burning house, which has been cleared by the police. Deep toned horns and shrill whistles give the signal for attack. The men climb up on the burning building in an instant. Under the ax of the sapper fall walls, burning beams, windows, and doors. All

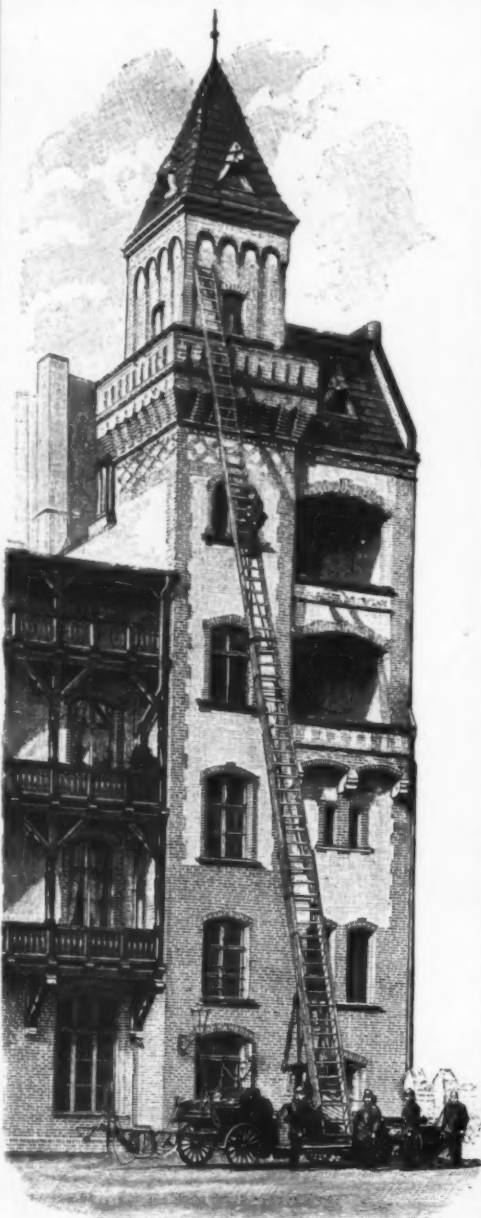
parts of the building which threaten to fall immediately, or may serve to spread the fire, are pulled down as soon as possible. And wherever the fire is most dangerous, where walls, pillars, and beams are falling with a crash, we will always see the officers and their brave men fighting the fire under the command of the branddirektor.

At first, the water is taken from the water cart, but the hose is soon connected with the street hydrant, and then streams of water are playing from all sides on the glowing walls and into the flames. If the water pressure is not sufficient for the highest points, the steam engine is used. With a pressure of about eight atmospheres great masses of water are thrown into the flames with a velocity of at least three hundred gallons per minute.

The people of Berlin have reason to be proud of the brave men who literally "go through fire" for them.—Illustrirte Welt.

LAVA ERUPTIONS IN HAWAII.

LAVA is the chief eject of these island volcanoes, and is so thin—almost like molten glass—that when the wind catches it up, it is drawn into slender filaments, which go by the name of "Pele's Hair," Pele having



MECHANICAL LADDER AND PRACTICE TOWER.

been, in the old Hawaiian mythology, the goddess who presided over the action of these fire fountains, and had her seat in the crater. Some of these are of prodigious extent; for instance, that of 1852, which proceeded from an eruption of Mauna Loa, formed an unbroken fountain of lava 200 to 700 feet high and 1,000 feet broad, though it did not burst out of the crater, but from the base of the cone. The first eruption of which we have a distinct record occurred in 1780. It was accompanied by fearful earthquakes, dense darkness, and terrific thunder and lightning.

An island war was raging at the time, and a body of men marching from Hilo to Kau were encamped by the volcano when the outburst began. Terrified, they halted for two days, and on the third divided into three companies and started at short intervals. Of the foremost company, some were burnt to death by sand and cinders, thrown to an immense height, and overwhelming them. The third body escaped almost uninjured, but on coming up with the center party they found only corpses of men, women, and children. Contrary to the rule, the eruption seems to have consisted solely of sand and scoria, with volumes of steam and sulphurous vapor. In 1823 the lava stream was thirty miles long. In 1840 the bed of the crater of Kilauea sank about 300 feet, and her fires vanished underground "with roaring and much commotion, till they broke

open a passage in the district of Puna, whence they rolled onward, burning forests, villages, and plantations—a terrific flood, from one to three miles wide and from 12 to 200 feet in depth, varying with the extreme irregularity of the ground, and having traveled a distance of thirty miles in four days, it entered the sea 17½ miles from Hilo, leaping a basaltic precipice about 50 feet in height, and forming a magnificent fire cataract a mile in width." All the time the surface was so clouded in steam and smoke that those standing on one side of the lava river could not see to the other shore.

Sometimes this "Mississippi of molten material" widened like a great lake, then narrowed as it "rushed through deep valleys, finally leaping into the sea in a cataract like Niagara, in a raging blood-red torrent." For three weeks, we are told, the flow continued. The sea boiled and raged madly as the torrent mingled with its waters. For twenty miles along the coast the waves were warm, and myriads of dead fishes floated on the waves. So intense was the glare that at places forty miles distant a "fine print" could be read all night by its lurid glow, and ships a hundred miles at sea beheld the strange light." On January 16, 1887, after violent earthquake shocks, which continued for several days almost without interruption, Mauna Loa broke forth in a lava stream which coursed down the southwest side of the mountain, entering the sea two miles north of that of 1868, though the fissure from which it flowed is twelve miles farther up the mountain, or twenty-one miles from the ocean. It was extremely copious, rising in several large fountains, from 100 to 200 feet high, and reached the sea in twenty-six hours in a current averaging about three-fourths of a mile in breadth, leaving behind it a hideous embankment of cinders, through the fissures in which, for several days subsequently, the fiery interior was disclosed.—Our Earth and its Story.

THE WEAR OF CHAINS.

By R. WEATHERBURN.

THE following article on the wear of chains is from The London Engineer:

The few accidents that occur to life and limb by the breakage of chains would tend to the belief that the quality of material from which they were made was exceptionally good, with frequent and capable examinations, or that a very generous margin of strength was allowed. The fact is that a far greater number of breakages take place than is ever known, but, in the vast majority of cases, are fortunately attended with no more serious result than damage to material and the inconvenience of delay; hence the complacency in which the indiscriminate and too often reckless use of chains is viewed.

The general application by land and sea, in workshops, factories, warehouses, shops, etc., must necessarily include a considerable proportion which never receive the benefit of periodical inspection. Nor is it to be supposed that a merchant or warehouseman should possess the knowledge, or have the time and desire, even if competent, to inspect such matters. It is generally sufficient for him to have repaired with the utmost dispatch or renew one which has caused trouble and delay by breakage. Even in the larger industries, where the services of engineers are more frequently requisitioned, the chains only receive desultory attention. It is only too true that the accidents that do occur are mainly the result of the margin of safe wear being exceeded, and that the tardy attention given is due to such unpleasant notifications.

Nearly every class of machinery is open to government inspection or control, but the chain of the builder's steam derrick or crane, high aloft, often over the heads of the passers-by underneath, conveying bricks from front to rear, or the long chain depending from the upper story of the warehouse, with its ascending or descending loads, seems to be left to the supervision of Providence alone.

It is not intended to suggest a remedy for this state of things, but simply to bring under force the wear attending the use of chains, and point out the cause for such.

VISIBLE AND INVISIBLE WEAR OF CHAINS.

There are two kinds of wear, which, for the want of a better title, we will designate as determinate and indeterminate, or visible and invisible, and both are the result of motion with weight. Both wears are contemporaneous, but not equal. The determinate wear is principally confined to certain localities or parts only, and can be looked for with certainty as being the results of simple or complex movements, which more or less alter the shape and size of links by abrasion, distortion, or weight, and can only be effectually dealt with by removal and substitution.

Indeterminate wear is unseen, and is the result of weight and movement, acting and reacting on the organic structure in such a manner as to produce a slow but sure change from the fibrous—which should be the normal condition—to the molecular or crystalline condition. The phases of these alterations are irregular in proportion to the irregularity of the stresses passing through and the portions or sections of chain acted upon. This physical and chemical change is assisted by changes of temperature. Indeterminate wear can be dealt with by periodical annealing.

Determinate wear is always greatest in ill designed machines, per se. Acute knuckling motion of links passing round pulleys of too small diameter readily suggests the importance of larger diameter pulleys; indeed, it should be an axiom of crane makers to lead the chain from one straight line to another by as large a radius as practicable, so as to reduce articulation of links as much as possible. Pulleys with too large a hollowed race or channel for the chain are responsible for a canting or rolling motion, which causes twists to form and rapid local wear. This, too, suggests the expediency or wisdom of using the groove shaped pulley whenever possible. At all events, it may be understood that the greater the number of pulleys, the greater the wear. These items, important in themselves, are simply proofs that wear is often produced, not so much by work done as the variation in the position of the links when doing it. Twisted chains—i. e., chains defectively made with a twist—as also others which have become twisted by mismanagement, evidence determinate wear with great rapidity, and so

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localized as to render it very dangerous. At times a badly twisted chain, say from $\frac{1}{4}$ to $\frac{1}{2}$ inch twist, will, in spite of the best lubrication and management, reduce the lifetime by one-half. The shorter the twist, the greater the local wear, and vice versa. It is the righting of the twisted portion under weight which causes the mischief, for with the most effective oiling the chain may be not one iota the worse in the straight parts and be worn dangerously at the twisted portion.

WEAR AFFECTED BY CONSTRUCTION.

There is another wear not produced by actual work, but by the return of the unloaded chain for the next lift, rubbing against surfaces, and caused by the want of proper guide pulleys. This wear affects the sides of links only, but is none the less very serious, see Fig. 1. The wear of chains is materially affected by their construction. This should be the better understood, seeing that every link represents a weld the soundness of which can only be proved by absolute wear. The guarantee tests are certainly very valuable, but not to the extent generally supposed. Chains which have been guaranteed and certified as tested have under normal loads been known to separate at welds, disclosing superficial welds—i. e., only the outer edges of scarfing having been united, and the middle black, as shown in Fig. 2. Fortunately it is a very rare occurrence for a chain to break at the sides of links. The ends not only exhibit the principal wear, but furnish over 90 per cent. of the fractures. Now, assuming the material to be only moderate, and the workmanship the same, it is easy to see that the results are in proportion. The bending of the links to the right curvature at the ends with such material, and with an imperfect heat, would be sufficient to impair permanently the fiber at the outside or point of greatest distension; but really in all cases of sharp bends the damage is greater on the inside, where the crushing together crowds the fibers out of shape, or, in other words, dislocates them, and it must not be forgotten that it is at these points that the most punishing strains are applied. The welding may be all that can be desired, and the wonder is that so few are bad, but there are peculiarities in the socket wear of chains, not breakages, which suggest that the same hand has not been

Indeterminate wear is not general throughout the length of chain, but is even more localized than outside wear, being subject not only to the same influences which produce outer wear—viz., weight and motion—but also to differences of temperature and vibrations, shocks, etc., which mostly affect those portions of chain which receive the most movement. For example, the portions most affected are those nearest the quick running pulleys, and the least affected are those which are on drums or slow moving pulleys. The influence of cold on the cohesion of chains is very remarkable, and should be taken seriously into account in cold weather or in cold countries. Fortunately, in spite of the insidious and dangerous character of the unseen wear, it can be dealt with much easier and more generally than determinate wear. The process of annealing, or, in other words, restoration, is so easy as to come within the range of every user of chain, although the easiness of the process may cause it to be carelessly done. Annealing can be accomplished in a furnace, but the temperature should never be more than that represented by what is known as red; any higher visual temperature may produce scaling, which would be loss.

The chain during annealing should remain at the red heat for at least two hours, and when removed be put to cool gradually in a sand or ash bath. When a furnace is not available, an improvised grid, composed of iron bars, each bar from one to two inches apart, with the ends resting on brick supporting walls from two to three feet high, can be built in the open, and the chain laid thereon, coiled in such a manner as to become pervious to the heat, built both under the grate and above, with wood fagots, maintaining the fire until the proper heat has been obtained. The result will be satisfactory.

For the making of chains, the shape and length of links are points of great importance. Long links, when used on pulleys of small diameter, undergo more motion—knuckling action—and consequently more wear than the short ones, besides taking up more strains. On the other hand, it is equally certain that a chain composed of longer links has a less number of welds than one of equal length composed of shorter links, and consequently less liability of defective welds. There-

Should the chain be well worn—i. e., socketed at the linking points—the surfaces become so close as to prevent ingress. Effective constant lubrication can never be obtained, as all sudden accessions of weight on such small areas of touch are sufficient to destroy the oil film and cause metallic contact and abrasion, so that partial lubrication under the most favorable circumstances is only obtainable, and that, too, by adopting the best plan—viz., periodically lowering the chain into a barrel of grease or oil of the proper consistency and viscosity to enable the unguent to have access to every part.

A limited elasticity is one of the needful requisites of a good chain. Without elasticity it becomes little better than a solid bar under weight; therefore, the form of the link has much to do with the longevity of the chain. If the links be too long and too much of the oval, the elasticity, provided the chain be duly proportioned, would be too great and beyond recovery; but with medium size links of the semi-oval pattern the elasticity would be such as to take off the severe shocks consequent upon quick lifting without seriously impairing their form.

STRESSES ON CHAINS.

The stresses to which chains are subjected as a rule come very irregularly, and it will be readily understood that they are exactly in proportion to the load in the case of a hand crane with slow movement and direct lifting without lurch or click, but with steam or hydraulic cranes, running at a speed much beyond that of hand lifting, it is impossible to estimate them by the weight lifted. Every lurch in the weight, every little click or adjustment of the chain, either in the pulleys or drum, causes a slight increase of weight. The lifting or stopping with speed has its immediate action on the chain, and it is amusing how the needle of the dynamic register, when used, is incessant in its movements during the quick lifting or lowering of moderately heavy weights, so that the normal elasticity of a chain stands as a reservoir of absorption to diminish these acute differences. A powerful brake mounted on an axle, so stubborn as not to show the slightest tendency to torsion, is one of the most effective agencies for the destruction of chains. A sudden application of a brake of this character does more harm to the internal and external wear than almost anything else, and it is only the native elasticity of the well proportioned and made link that can for any length of time stand against this trying ordeal.



THE WHIRLING SPIRAL.

Chains with small links are subject to much more friction than chains of medium sized links, although made from the same iron as the long links; such chains are by necessity sturdier, and although apparently equally as strong, are really more liable to break, owing to the greater difficulty of making sound welds; in short, links of strong material.

The molecular change or transition from the fibrous to the granular form, though it be slow or quick, is but a constant wear in proportion to the amount of work done and influence of the surroundings, and as the change progresses it only becomes a question of time to reduce the normal cohesion to such an extent as to render the chain no longer able to perform the work without breakage. Literally failing by exhaustion, therefore, it must be considered as wear. This internal wear is always the more rapid where the conditions of irregular weight and working exist. An ill adapted chain, where the links are not proportioned to the pulleys or barrel diameter, or badly shaped pulleys on which the chain never secures a proper seat, noisy and creaky work, are always very unfavorable to longevity, particularly where the chains are also subject to excessive cold or sudden great changes of temperature. The more silently a chain works, the better.

THE WHIRLING SPIRAL.

FORM a spiral out of a very thin piece of iron wire and coat it with oil so that the metal can float upon water. A solution of soap and water is then sucked up through a straw, the upper end of which is closed by the index finger. By alternately opening and closing this end, drops of soap solution can be made to flow from the straw. If upon the central portion of the floating spiral a drop of the solution is allowed to fall, then the spiral will revolve several times in the direction indicated by the arrow.

As soon as the spiral has come to rest, another drop is allowed to fall in the center of the coil, and immediately the motion will begin anew.

Without going extensively into a theoretical explanation of this phenomenon, we shall only state that by means of the soap solution we have checked a force called superficial expansion, to the influence of which the surface of the water is subject.

Instead of soap and water, spirits of wine, rum, and like liquids could have been employed. We have selected soap and water merely because a wash basin should be employed in this little experiment, and hence soap would naturally be the most available substance for the purpose in hand.—Illustrate Welt.



Fig. 2.—Showing Bad Weld



Fig. 1.—Showing Wear at Sides of Links



Fig. 3.—Link Worn at End Only.



Fig. 4.—Wear at Sides of Links.



Fig. 5.—One Link Only Worn.



Fig. 6.—Showing Links Drawn In.

THE WEAR OF CHAINS.

equally sure. The rapid wear at one link of a chain, or at one end of a link, see Fig. 3, working under precisely similar conditions to the other, can have but one solution—viz., the link in question, by more or less hammering at doubtful temperatures, has become softer or spongy.

Wear to breakage is largely due to socketing, see Fig. 4, but in proof of isolated wear it is occasionally found that one link only of the two so engaged is badly socketed, see Fig. 5; but as this rarely occurs, socketing is fairly represented by equal wear, not of all links, but of the two links engaged. Before ever the stage of attenuation has been arrived at, as shown, a disintegrating force has also been at work, and it is simply due to the margin allowed that the chain has not come to grief. Socketing is very largely due to want of lubrication, and to extra movement at that part or link, and it may safely be claimed that such extraordinary local wear is often the result of a combination of evils.

DEFECTIVE WELDS.

Defective welds are of two kinds—viz., those where scale or dirt intervenes and prevents a portion of the surfaces coming into contact, and others by a deficiency of temperature, causing only partial union, and not a true welding of the two surfaces. The former are the most difficult to detect, as the process of hammering out the scarfs, as a rule, leaves the surface a little hollow, causing the edges of the scarfs to unite, and imprisoning the dirt or scale in the hollow formed by the convex face of hammer. The writer has known such defective welds to defy the closest examination by glasses, and in one instance, where the chain—a very heavy one—had been certified as duly tested and guaranteed, it broke at a much lighter weight than that for which it was specified; and no wonder, for the weld was so very partial as to comprise but a fraction of the area of the weld, representing a complete ring, but in width less than 1-16 inch all round, inclosing a black area of hammer marks. The latter welds—viz., those attempted at imperfect temperatures—are, in spite of the means adopted to hide them by hammering, as a rule, observable, owing to the edges not uniting. This view must not be taken as arbitrary, for the edges of the scarfs cool down quicker than the body, and sound welds often display suspicious edges.

fore, the length of links should be carefully proportioned to give the minimum of articulation without unduly increasing their number or rendering them too short for sound welding. Chains in use always become longer, not alone in consequence of wear at points of touch, but also due to elongation or lengthening of links, produced by sudden strains and heavy work. A chain when properly proportioned for a certain weight should practically recover itself after such elongation, and no better proof is required that the elastic limit of the chain has not been overstepped. Wherever serious permanent elongation of such a chain has taken place it may be safely assumed that it has been subjected to rough usage, or that the proper weight has been largely exceeded. These points lead us to the question of what constitutes a properly shaped link to give the needful recovery after proper use. Now a chain which has received violent treatment beyond the elastic limits is always narrower and longer in the link than previously, and one of the peculiar evidences of such treatment, and particularly noticeable in light chains with long links, is the indrawn sides of the links, which in severe cases become narrower than the diameter of the iron, and hold each other in a viselike grasp, Fig. 6, and the chain is practically inarticulate and no longer workable, but when this occurs it proves conclusively that the material is at least good. The indrawing is merely the disposition of the sides of links to follow in the line of forces which pass through the other engaging links. Such goes to prove that the sides of links should never be parallel unless unavoidably required, and each side should form an easy radius.

The lubrication of chains, although long practiced by many, is not the unqualified benefit supposed. In some instances this want of success is due to the system pursued and in others to the lubricant used, but mainly both system and lubricant are faulty. The application of lubricant to a chain at full stretch in position is at best a very imperfect one, as the points of contact of the links are so small that but a slight weight precludes the ingress of the oil. Again, oils or grease with good viscosity lack the fluidity necessary to get to the points named, and if rendered fluid enough to do so, no longer possess the needful viscosity to benefit, and are easily excluded with light weights.

A NEW CENTERING TOOL.

A HANDY form of tool for centering round bars from 2 inches to 8 inches diameter is shown by the accompanying cut and drawing. It can be used either in a lathe, as, for example, when a number of bars have to be centered, or may be merely clamped to the end of the piece, as, for example, when dealing with a long shaft, and rotated by hand.

Referring to the drawing, the drill chuck, *D*, is driven by means of the pinion, *P*, and the internal gear wheel, *G*, the latter being driven from the catch plate of the

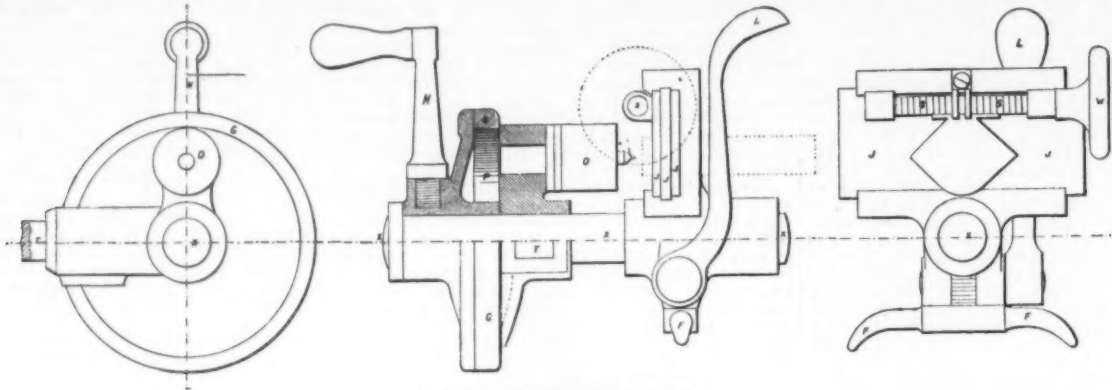
6. It is unlimited, it being possible to extend it to any length or over any space, while a crane is complete within itself, and when more room is required, a new and separate crane must be built.

7. It consumes no room like a crane does, the entire track is hung from the roof or supported by columns, while a crane swinging in a circle has at least a 15-foot circle in the center that is useless and does not reach the corners.

8. It requires no heavy foundation and is not a strain upon the walls of the building, pulling them out of shape, with the roof also, as many a crane has done.

amount of time and toil by having facilities there to handle the heavy cores and plates. The same system can be run to the cleaning room and the castings removed from the foundry by its use, and from there direct to the machine shop. In fact, in many places around such plants the thing can be utilized to a wonderful degree.

The Crescent Iron Works, at Springfield, Mo., recently erected a trolley track outdoors for the purpose of loading and unloading cars. It was composed simply of a number of columns 24 feet high set in V shape inverted, which carried a 15-inch I beam upon which



A NEW CENTERING TOOL.

lathe or by hand by means of the handle, *H*. The gear wheels are entirely closed in as a protection against dirt, etc. The vise is self-centering, the jaws, *J*, being caused to approach each other and grip the work by means of the right and left handed screw, *S*, and the hand wheel, *W*. It is keyed to the stationary shaft, *A*, on which it is caused to slide by means of the feed lever, *L*, which is keyed to a pinion working in a rack above it, thus pressing the end of the work against the point of the drill.

When used in connection with the lathe, the tool is supported by the shank, *T*, which is held in the slide rest. When used for centering by hand, the vise is

When used in conjunction with air hoists and compressed air, there is no question as to its value, and any concern that does work which requires any amount of heavy lifting or crane work can pay for the entire expense of erecting a suitable system in one year's time by the labor saved and confer a favor of no small proportions upon their men by relieving them of the heavy, hard, laborious part of their duties.

How many have stepped into foundries, those who are conversant with the business, and watched the great, cumbersome 20 or 30 ton traveling crane expend its force, time, and wear on machinery to lift a little casting or flask that would not weigh over 1 000 lb., while

the trolley runs. A 16-inch air hoist, 6 feet long, was attached to the trolley. This was comparatively a cheap structure and will pay for itself the first year of its operation. Formerly, when an engine or boiler was to be loaded, or any machinery or castings, it was accomplished by hand. Now it is run under the trolley track on a truck and 4 or 5 ton loads are picked up and loaded on the cars by two men in almost as few minutes.

There are a number of different styles of trolley systems, many of which are good, but the double rail is always preferable. In the April and May issues (1896) of *The Foundry*, the writer showed several different types, one with wrought iron rails and cast iron hangers, and the other with both cast iron rails and hangers, both of which have been tried by hard service and found very satisfactory. These tracks cost about \$1 per foot erected. A Western concern, about four years ago, put in 400 feet at a total cost, including switches, of \$400. This was principally used over heavy side floors and on light crane work, and the saving in labor, including carrying iron, is fully \$400 per annum, or the cost of the structure. It covers eight floors, and is not used on all of them at one time, will not average over four constantly, which makes this facility worth \$100 per annum per moulder when in use constantly. It is not safe to assume that every investment of this character will yield 100 per cent. profit in a year, but it is safe to assume it will return not less than 30 per cent. per annum.

The Murray Iron Works, at Burlington, Ia., and the Atlas Engine Works, of Indianapolis, Ind., use similar tracks, and from observations as to the use they put them and their probable cost, it is perfectly safe to say they pay 50 cent. per annum.

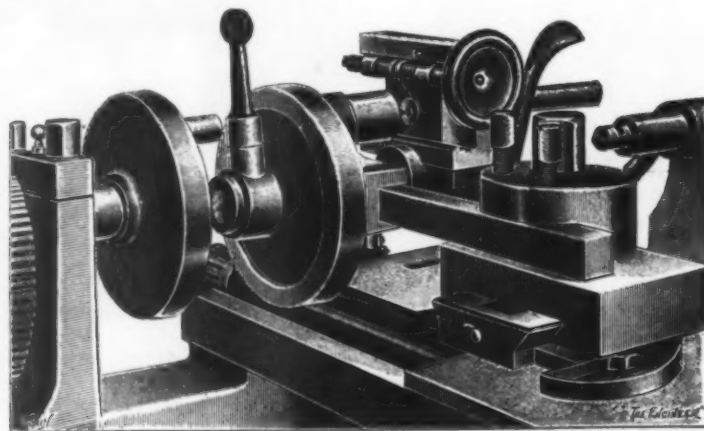
There is little question as to the cost of such an improvement. The actual value of the thing, the profit it brings, speedily sets the question of first cost aside, and the great consideration is, how much do you need? It is a very difficult question to answer how much money so much track will save or how many men so much track will supplant. There are places where \$50 worth of track will save the labor of one man constantly. There are other places where it will require \$400 or \$500 worth of track to save an equal amount, but it is true that, wherever anything has to be handled by crane, wheelbarrow, truck or hand, the overhead trolley will speedily pay for itself and prove its value. Put this track over the floor of a moulder doing heavy side floor work, and what does it save? 1. The man does his own lifting—you save his time and others' who would have helped him. 2. He pours off his floor and saves the customary man to help carry off, and last, he shakes out that dirty, disagreeable part of the business. You have saved money, time, and your man.

THE PORT OF LIVERPOOL.

PARLIAMENT has just passed two acts giving the necessary authority to the Mersey Docks and Harbor Board to make the proposed improvements and extensions in the Liverpool dock system.

The total amount authorized by Parliament to be spent on these improvements is larger than the sum originally estimated. The exact total provided for in the two acts is \$24,115,320. Of this amount, \$6,804,000 is supplementary to the sum of \$7,776,000, authorized by a special act of 1891, to be expended for extending, deepening, and otherwise improving the docks. These improvements are nearing completion. Under the act of 1891, and the two acts just passed, there have been authorizations for the enormous expenditure of \$31,891,320 for the improvement of the Liverpool docks. Even this amount does not give the grand total. The acts of 1891 and 1898 are for special and extraordinary improvements; and, in addition, there are the ordinary improvements made from time to time and paid for out of the current revenue of the board.

The last of the sailing pilot boats has just been withdrawn from active service, and now the Liverpool pilot boats are all steam vessels. Formerly there were six sailing pilot boats, but now four steamboats perform the service. The total cost was \$158,679. There are 212 pilots at present in active service, and of this number 44 are attached to certain large steamship companies and are called special pilots. In addition to the four regular steam pilot boats there is a steam launch for river work, and one of the sailing pilot boats has been retained as a reserve boat in case of accident to one of the steamboats. These steam pilot boats are



CENTERING TOOL FIXED IN LATHE.

clamped on the end of the shaft to be centered, and is supported on the feet, *F*. We give a separate view of the cutting tool enlarged.



The tool is made by Mr. Edward G. Herbert, Cornbrook Park Works, Manchester.—The London Engineer.

"TROLLEY SYSTEMS—THEIR VALUE IN FOUNDRY WORK."

By HERBERT M. RAMP.

THE overhead trolley system is one of the most modern of improvements in the foundry and connecting departments, and bids fair to almost entirely supersede all other methods of carrying and handling light as well as heavy loads. Their adaptability to all kinds of work, the ease with which they can be operated, the amount of labor they can save, and the nominal cost at which they can be erected have opened a wide field for their use, and it can be truly said that, when properly erected, there is no machinery placed about a foundry and machine plant that can demand better claims to being classed as labor-saving and dollar-saving machinery.

This is the evolution of the crane, and the trolley system is gradually crowding these clumsy, ill-looking, room-consuming creatures of the past to the wall, and while there have been wonderful improvements in our cranes, they cannot expect to equal the modern trolley system. The advantages of the same are great and a few of its good points are as follows:

1. It will cover more territory at a lower cost.
2. It will work quicker than any crane built.
3. It can be operated more easily and with less labor than a crane.
4. It can be erected and operated in places where a crane could not.
5. It is maintained at a lower cost for repairs than cranes.

other men stood waiting for it, consuming twice the amount of labor and time a good trolley system would? Is this economy? True, the heavy crane has its place, but there is much more light lifting and handling than there is heavy, and the wide awake, progressive foundrymen of the day will make other provision for handling light loads quickly and cheaply. We have seen moulders and helpers stand for ten minutes around a large flask waiting for a lift because there was no room under the crane, and such work had to be made on the side floor anyhow, because the crane was so slow. How many foundrymen ever stop to figure what that lift cost, and what it would cost if they had a trolley system and compressed air, so one man could handle it himself, and how many such lifts are made in a foundry in a year? If you do, you will find the figures surprising. You have noticed men pulling and struggling to get heavy cores from the core room to their moulds. Yes; and we see a dozen places every day around a foundry where this device would save labor, money, and time.

Trolley systems can be erected to run from the cupola or standing ladle direct to the floors, and ladles holding from 600 to 1,500 lb. of iron easily handled and poured by the moulders, saving the labor of helpers to carry the small ladles, and being a great advantage in being able to more nearly put the exact grade of iron in each class of work than when carried by hand. It also reduces confusion in the shop at casting time, for fewer men are required to handle the iron and fewer ladles are in operation at one time, and last, but not least, your men will end their day's work fresher, be able to accomplish more of it and do it better, because their physical abilities will not be exhausted by the hard, hot labor of carrying iron. If it is expected for men to do more work or better work, and the condition of times and nature of competition make this a necessity, take the hard labor from them, the heavy lifting, the wearisome iron carrying, and you instantly put them in a condition to do more work and also to do it well.

These same tracks can be utilized for all kinds of crane work, any number of trolleys can be run upon the tracks, and every moulder can have a crane to himself, and never be put to the trouble of waiting or changing rigging. The tracks can be run to core room and all heavy cores handled direct from them to the moulds, also saving the core makers an immense

* A paper read before the American Foundrymen's Association, June, 1898.

very swift and strong. Two of them have a tonnage of 274 tons and two of 275 tons. All of them have a draught of 10 feet. They have been specially built to enable them to stand any sea.—James Boyle, United States Consul at Liverpool.

VERTICAL DUPLEX GAS ENGINE.

Two pairs of gas engines, of entirely novel construction, have lately been installed in the new warehouse of Messrs. C. Bayer & Company, Victoria Buildings, Golden Lane, London, E. C. They have been constructed by the Griffin Engineering Company, Kingston Iron

Works, Bath, England, under the patents of Mr. S. Griffin, and their design is shown by the engravings on this page. The engines are applied to driving dynamos for the lighting of the warehouse; each engine drives one generator through a countershaft, the plant being so arranged that either engine can be coupled to either machine. We are informed that the cost for gas and lubrication is under 15d. per Board of Trade unit, and that the owners find the arrangement much more economical than taking their supply from the mains. In the city of London artificial light is required a great many hours a day in the winter, owing to the general gloom, and this is particularly

true in the kind of business carried on by Messrs. Bayer, who employ a large number of workwomen. Hence a private installation has the advantage of a high "load factor," and can compete with the immense plant of a public supply company.

A glance at the illustrations shows that the engine departs very far from the usual design of a gas engine. Its most striking peculiarity is that it is vertical, and that the cylinders are supported on four massive steel pillars. Of course, there have been vertical gas engines before, but they have been of insignificant dimensions. Even the larger oil engines which have been built for boat propulsion have been quite small in comparison with the engines we illustrate, which, at 180 revolutions, give 46 indicated horse power and 40 brake horse power each. The gas engine seems to lend itself particularly well to the vertical design, since the very heavy and sudden strains to which it is subjected can be admirably met by placing the cylinder on four pillars. Certainly there is a marked absence of vibration in connection with these engines, and it is not nearly so easy to distinguish between explosion strokes and non-explosion strokes as is usually the case with horizontal engines. The saving of space is, too, a very important matter in places where ground is so valuable as it is in London.

A second feature of novelty is the "duplex" arrangement of the cylinders (Fig. 2), there being two cylinders, but only one connecting rod. The section shows the construction perfectly; it will be seen that the two cylinders are combined in a single water jacket, and that the two pistons are coupled together by a steel crosshead. The trunk pistons are very long, and work each in its own cylinder for its entire length. The inner sides of the cylinders where they form guides are cut away to allow the crosshead to pass. Each piston is bolted to the crosshead by four bolts, and in addition there is a central bolt passing through the entire length of the piston.

The engine works on the four-stroke cycle, there being an explosion at each stroke in one or other of the cylinders. A single cam, on the upper end of a vertical shaft, operates both sets of valves. Inlet and exhaust valves open direct into each cylinder, being operated by ordinary levers from the cam. The ignition of the charge is effected by two incandescent tubes, arranged side by side in one chimney and heated by a single Bunsen flame. A single gas valve supplies both cylinders. It is controlled by a hit-and-miss device operated by a centrifugal governor. It will be noted that the

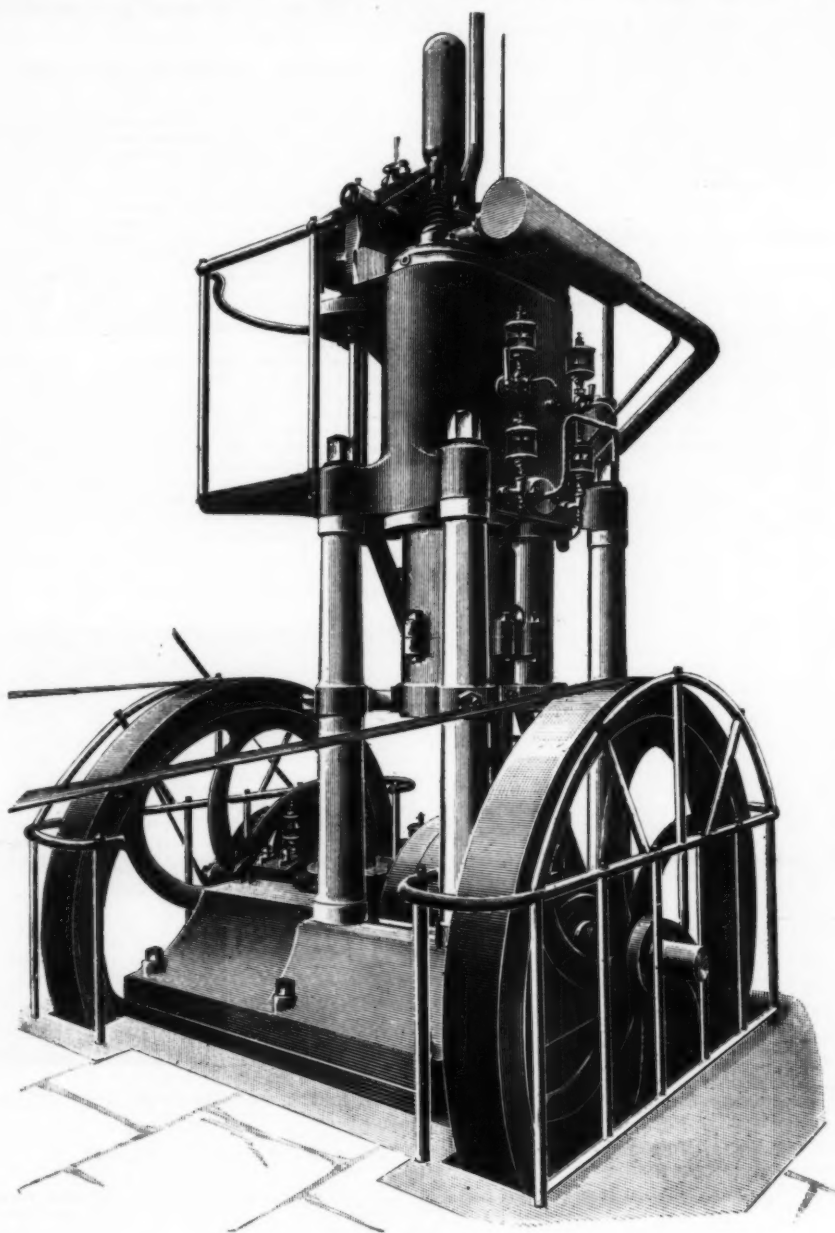


FIG. 1.

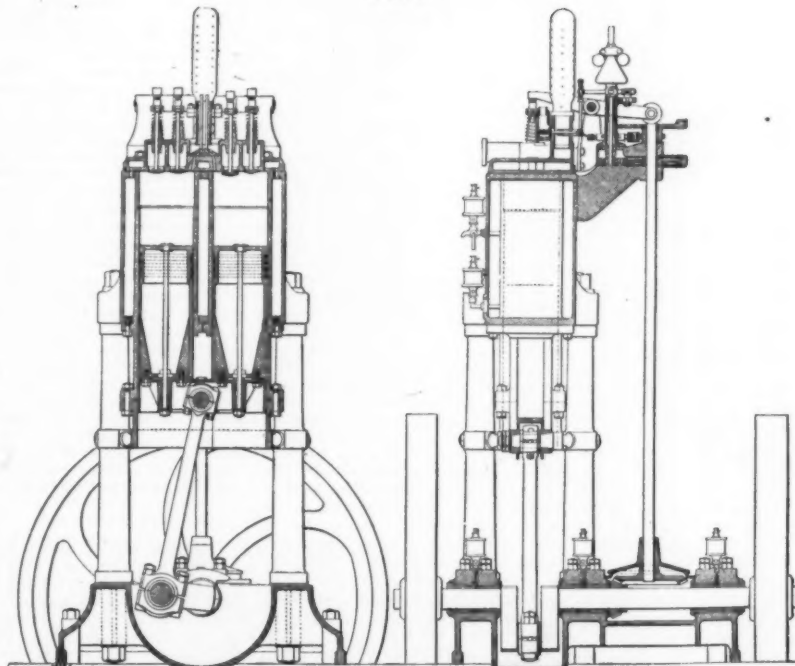


FIG. 2.

FIG. 3.

VERTICAL DUPLEX GAS ENGINE.



FIG. 4.

combustion chamber and passages are entirely water-jacketed.

The dimensions of the cylinders are: Diameter, 10 $\frac{1}{4}$ inches; stroke, 15 inches. We are informed that the consumption of gas is 18 $\frac{1}{2}$ cubic feet per indicated horse power and 21 $\frac{1}{2}$ cubic feet per brake horse power.

As the engines have to make long runs without stoppage, special pains have been taken to render the lubrication continuous and reliable. There are two sight feed lubricators fixed to the water jacket, delivering into oil wells on the crosshead, from which pipes lead to the crankpin and tailpin of the connecting rod.

The workmanship of the engines is first rate throughout. The running is exceedingly steady, giving satisfactory lighting by incandescence lamps down to quarter load. The mechanical efficiency is high, due to the form and construction of the engine, and the entire installation does great credit to the Griffin Company.—Engineering.

THE HARDENING AND TEMPERING OF STEEL.

THERE are at present many theories which have been brought forward by metallurgists to account for the phenomena of "hardening" and "tempering" exhibited by steel. It is well known that if a piece of steel be heated to about 1,500° Fah., and then suddenly cooled by immersion in water, it becomes very hard and brittle, offers greater resistance to the passage of an electric current, is much more difficult to magnetize, and its relative density becomes smaller than when unhardened. By reheating this hardened steel to temperatures varying from 390° to 750° Fah., it becomes less brittle, and is then said to be "tempered." A similar change will be found to take place to a small extent spontaneously, if the hardened steel be left undisturbed.

M. Chatelier, the eminent French metallurgist, in a recent number of *The Metallurgist*, points out that these phenomena are explained if we regard steel as a solid solution of carbide of iron (Fe_3C) and pure iron in an alloy of carbon and iron. It is well known that if a hot solution containing one of its constituents in excess be allowed to cool, this constituent will crystallize out until a point is reached at which the solution is saturated for two constituents; at this point both constituents will begin to crystallize, and the solution at this stage has a fixed composition.

In melted steel, it is probable that the carbon crystallizes out first, and then the mixture of carbon and iron known as "pearlite," the crystallization of which is attended by the physical phenomenon of recalcence, heat being given out as the separation proceeds.

If we allow a mass of molten steel to cool, and at the same time take successive observations of its temperature, the point at which recalcence takes place can be readily determined, for it will be found that the temperature does not fall regularly, but at one point it begins to rise, and then falls again, and it is at this point that pearlite begins to separate. If the separation of pearlite be prevented by sudden cooling, the mass of metal will exist in the condition which was stable at the temperature to which it had been raised, and as this condition is unstable at ordinary tempera-

tures, the metal tends to assume a stable condition, or, in other words, it tempers to a certain extent spontaneously. This explanation is borne out by analysis of hardened and annealed steels, when it has been found that hardened steel leaves no carbonaceous residue on solution in acid, while such residue is obtained in the case of steel which had been slowly cooled.

Another recent explanation of the phenomenon of the hardening of steel has been suggested by Mr. Howe, based on the assumption that when iron is heated to 1,380° Fah. it exists in an allotropic form, which would appear to be a sound assumption, since iron at this temperature becomes non-magnetic, and has a very high electric resistance, and if heated beyond this point its electric resistance does not increase, as it should normally do; so that, according to Mr. Howe, the quenching of hot steel simply converts this allotropic modification of iron into the ordinary variety, and the tendency to temper exhibited by hardened steel is due to the gradual separation of the other constituents.

CENTRAL STATION STATISTICS.*

THE exhibit made in the accompanying tables of the central station electric lighting business of the United

States, accepted as substantially correct. While in comparatively a few cases full information is lacking in the individual reports, these deficiencies have in the main been supplied with careful and close estimates, so that the variation from absolute accuracy is not of material importance. The extent of the business, its division between public and private ownership, the relative distribution of the different systems of lighting in use, and the power employed in generating the current, approximate so closely to the facts that no qualification of the figures is required; this is only necessary in respect to the item of capitalization, which, though representing closely enough the capital stock issued, is not to be taken as showing exactly the investment in the business.

It will be noticed from the individual reports of the lighting companies that some of them are also engaged in making gas, pumping water, making artificial ice, or supplying current to street railways. The capital stock as reported by such joint companies includes the investment required by them for their work in these allied lines, so that the exact amount of capital devoted to electric lighting from central stations is somewhat less than that shown by the total. No data are as yet available to show how much of the capital

light plants that has been carried out in so many of the larger cities and towns.

There is reported a total of 2,594 central stations operating in the United States, of which 333 are owned by the cities and towns in which they are located, and 2,261 are under the control of private capital. These stations operate in the aggregate 290,515 arc and 7,605,574 incandescent lights, employing for this purpose 1,038,231 horse power in steam and gas engines, turbine and other water wheels. Of the arc lights, 263,351 are of the ordinary series type, while of the remainder 18,411 are on low tension direct and 8,753 are on alternating circuits. The incandescent lights are divided between the direct and alternating systems in the proportion of 2,353,433 of the former and 5,252,141 of the latter.

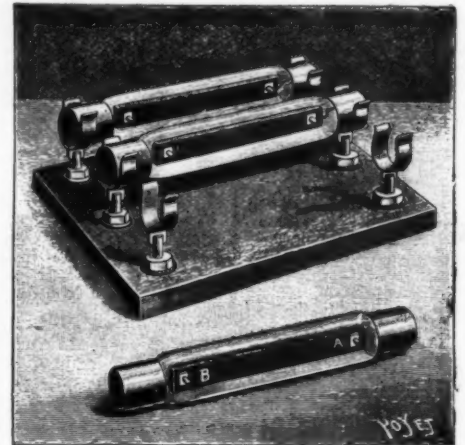
ELECTRIC HEATING AND ITS APPLICATIONS.

In the various electric heating apparatus thus far manufactured quite large resistances are so wound that at the time of the passage of the current the wires shall reach a determinate temperature. In order to prevent any distortion in contact with the air, all the wires are inclosed in an insulating composition. The result is that every wire of a kitchen or heating battery must be changed and adapted to new requirements.

M. Le Roy has recently devised a new method of electric heating which consists in employing what he calls an "electric log," and which permits of utilizing the present material without any change. The apparatus that allow of such utilization are very simple and very easy to use.

The electric device manufactured by M. Le Roy is represented at A B in the accompanying figure, borrowed from La Nature. A piece of graphitoid or crystallized silicium, about 4 inches in length, $\frac{1}{4}$ inch in width, and $\frac{1}{8}$ inch in thickness, is placed in a glass tube and connected at its extremities with copper mountings, and a vacuum is finally formed in the tube. It then suffices to arrange several of these devices between special current collectors in order to form a heating apparatus—either a radiator or a kitchen stove. It is possible to manufacture a series of small portable and separate elements easily placed in the openings of a range.

Graphitoid silicium has been particularly selected by



LE ROY'S NEW ELECTRIC HEATING APPARATUS.

A B, one of the elements.

M. Le Roy on account of the high specific resistance that it presents. In fact, he has found by experiment that a bar 4 inches in length of 1.75 inch square section has a resistance of 200 ohms with silicium, 0.75 ohm with carbon, and 0.00085 ohm with German silver. The superiority of silicium for such applications is, therefore, well established. At 800 degrees the resistance decreases from about 35 to 40 per cent.

In a communication to the Society of Civil Engineers, M. Le Roy made a very interesting comparison of the net cost of the different sources of heat. He stated that he had found that one kilogramme of coal disengages 7,500 kilogramme-degree heat units; one cubic meter of gas, 5,253; and one kilowatt-hour, 864; although such figures are notably diminished if we take account of the practical conditions of heating.

M. Le Roy has found that in order to have electric heating enter into competition with heating by coal, the selling price per kilowatt-hour must be 0.0288 of a franc for the heating of apartments and 0.0259 of a franc for domestic purposes. So, too, in order to compete with gas, electric energy would have to be sold at 0.195 of a franc and 0.111 of a franc per kilowatt-hour.

We are far, as yet, from meeting with such prices in the industries, says La Nature, since in the various sectors of Paris the charge for electric energy for calorific applications is from 0.4 to 0.5 of a franc per kilowatt-hour. But it seems very difficult to establish a comparison between net costs under the conditions of which we have just spoken. Experiment alone will be able to furnish accurate elements to judge from, through the heating of the same room under the same conditions of temperature and noting the respective expenses.

According to the International Patent Bureau in Berlin, soot obtained from acetylene is a very valuable product. Acetylene gives, when burnt with a smoky flame, a three to four times greater quantity of soot than an equal quantity of mineral oil. The product is extremely light and the particular value lies in its deep black color, which shows not the slightest admixture of brown. It is also free from tarry matter, which is always found in ordinary lamp black. For the preparation of printing ink and dyestuffs it is uncanceled.—Südd. Ap. Ztg.

Central electric lighting stations in the United States owned and operated by private corporations, firms and individuals.

State.	Number of Central Stations.	Capital Stock.	Number of Arc Lights.				Number of Incandescent Lights.			Engine Horse Power.
			Series.	D.C. Inc.	A.C. Inc.	Total.	Direct.	Alternating.	Total.	
Alabama.....	22	\$1,813,700	2,064	60	49	2,781	7,825	22,150	29,975	7,380
Arizona.....	6	500,000	143	8	151	1,900	1,900	7,000	8,900	1,305
Arkansas.....	21	1,307,500	865	111	75	1,041	9,155	15,063	24,219	4,225
California.....	74	17,363,000	9,807	127	303	10,237	107,000	132,610	239,610	30,485
Colorado.....	46	4,654,500	3,576	64	28	3,668	44,210	103,365	147,575	19,865
Connecticut.....	34	4,658,500	5,054	198	16	5,268	36,175	84,700	120,875	16,780
Delaware.....	1	250,000	300	.....	.....	300	12,500	10,000	22,500	1,300
Dist. of Columbia.....	2	1,525,000	550	.....	.....	550	30,000	1,200	31,200	3,800
Florida.....	14	531,000	1,125	1	106	1,232	2,050	17,500	19,550	5,195
Georgia.....	23	2,045,500	2,080	16	316	3,012	4,950	58,800	63,750	10,745
Idaho.....	12	330,000	292	.....	.....	292	5,000	4,545	9,545	2,085
Illinois.....	206	14,542,550	14,516	4,202	452	19,230	250,655	421,777	721,442	71,230
Indiana.....	101	6,066,620	9,717	38	146	9,901	38,900	148,770	187,760	31,565
Indian Territory.....	1	1,000	.....	.....	.....	.....	1,000	.....	1,000	125
Iowa.....	109	6,500,000	4,838	350	185	5,363	48,885	145,440	194,325	29,345
Kansas.....	56	3,107,000	3,223	204	25	3,492	28,515	60,450	88,965	14,920
Kentucky.....	33	2,07,800	3,000	10	74	3,174	3,925	92,515	96,440	10,390
Louisiana.....	7	800,725	2,310	2	.....	2,312	180	43,000	44,800	7,135
Maine.....	20	2,210,000	2,310	10	6	2,326	20,900	67,495	88,395	16,150
Maryland.....	25	3,967,000	4,463	148	15	4,626	9,800	69,900	79,700	13,235
Massachusetts.....	110	17,749,000	23,275	1,586	194	25,017	212,175	481,363	693,538	120,490
Michigan.....	105	6,364,500	8,311	1,028	253	9,602	106,673	307,800	414,473	37,025
Minnesota.....	42	4,834,000	4,380	344	13	4,737	51,985	98,690	150,675	16,840
Mississippi.....	13	1,556,500	620	12	10	642	2,100	11,850	13,950	2,470
Missouri.....	72	9,449,500	7,872	37	915	8,844	18,350	290,310	308,660	29,095
Montana.....	17	1,131,000	1,415	73	14	1,504	5,300	64,425	69,725	7,045
Nebraska.....	27	3,084,250	1,486	60	72	1,618	6,500	43,515	50,015	7,855
Nevada.....	3	310,000	185	.....	.....	185	1,050	1,050	2,100	305
New Hampshire.....	41	3,082,500	3,070	40	21	3,131	12,940	91,020	103,960	17,445
New Jersey.....	60	6,876,450	9,080	79	136	9,295	54,925	153,280	210,305	33,525
New Mexico.....	5	.....	90	.....	.....	90	1,000	4,800	5,800	750
New York.....	194	39,825,000	23,367	5,970	3,538	42,911	560,810	612,530	1,173,340	130,490
North Carolina.....	18	833,100	815	13	.....	828	8,005	13,850	21,855	2,195
North Dakota.....	7	425,000	110	22	.....	132	3,450	6,000	9,450	1,235
Ohio.....	132	11,361,000	17,065	882	225	18,192	130,400	194,005	324,405	44,505
Oklahoma.....	4	390,000	180	.....	.....	180	3,400	.....	3,400	550
Oregon.....	96	4,560,000	1,891	14	.....	1,919	4,370	43,325	47,695	10,775
Pennsylvania.....	213	17,942,085	28,936	1,473	596	31,007	296,135	562,710	858,845	100,370
Rhode Island.....	13	3,064,500	5,000	78	4	5,142	12,170	66,220	78,390	13,600
South Carolina.....	13	471,600	605	12	85	702	1,050	14,100	15,150	4,920
South Dakota.....	17	690,500	380	2	15	377	5,560	12,300	17,860	3,310
Tennessee.....	32	1,247,300	2,120	11	110	2,241	855	75,250	76,105	9,730
Texas.....	67	4,554,500	2,870	66	95	3,031	17,455	98,065	115,520	17,940
Utah.....	8	751,000	910	.....	.....	910	1,150	14,600	15,750	4,090
Vermont.....	23	862,300	1,230	20	24	1,274	5,000	45,940	51,080	7,755
Virginia.....	28	1,254,500	2,025	62	68	2,155	18,100	21,805	39,905	7,770
Washington.....	32	1,507,800	2,280	50	10	2,345	31,760	31,100	62,860	8,800
West Virginia.....	24	1,072,600	670	34	21	725	6,140	38,000	44,140	4,430
Wisconsin.....	87	6,343,275	6,045	261	106	6,411	39,910	139,460	180,370	27,150
Wyoming.....	6	297,100	235	30	.....	275	9,250	3,975	13,225	1,500
Totals.....	2,301	\$229,038,605	238,125	17,068	8,335	354,428	2,294,188	4,939,940	7,234,128	970,481

Central electric lighting stations in the United States owned and operated by municipalities.

State.	Number of Central Stations.	Number of Arc Lights.				Number of Incandescent Lights.			Engine Horse Power.
		Series.	D.C. Inc.	A.C. Inc.	Total.	Direct.	Alternating.	Total.	
Alabama.....	2	.....	.....	.....	.....	.....	900	900	180
Arkansas.....	2	.....	.....	.....	.....	.....	300	300	325
California.....	4	.....	.....	.....	.....	.....	3,400	3,400	565
Colorado.....	1	.....	.....	.....	.....	.....	300	300	80
Connecticut.....	1	.....	.....	.....	.....	.....	.....	.....	300
Delaware.....	4	.....	.....	.....	.....	.....	900	4,000	440
Florida.....	2	.....	.....	.....	.....	.....	9,000	9,000	690
Georgia.....	8	.....	.....	.....	.....	.....	6,890	6,890	965
Illinois.....	34	.....	.....	.....	.....	.....	15,130	30,570	5,660
Indiana.....	18	.....	.....	.....	.....	.....	18,930	19,530	4,295
Iowa.....	23	.....	.....	.....	.....	.....	12,560	29,150	3,500
Kansas.....	3	.....	.....	.....	.....	.....	1,300	1,300	190
Kentucky.....	5	.....	.....	.....	.....	.....	1,100	1,100	630
Louisiana.....	1	.....	.....	.....	.....	.....	2,000	2,000	300
Maine.....	2	.....	.....	.....	.....	.....	6,000	6,000	4,025
Maryland.....	1	.....	.....	.....	.....	.....	.....	.....	85
Massachusetts.....	11	.....	.....	.....	.....	.....	25,000	25,000	4,455
Michigan.....	35	.....	.....	.....	.....	.....	8,475	42,550	8,170
Minnesota.....	25	.....	.....	.....	.....	.....	14,650	26,400	3,070
Mississippi.....	1	.....	.....	.....	.....	.....	1,800	1,800	330
Montana.....	19	.....	.....	.....	.....	.....	2,150	29,970	3,025
Nebraska.....	1	.....	.....	.....	.....	.....	1,550	1,350	175
Nevada.....	6	.....	.....	.....	.....	.....	1,500	1,000	425
New Hampshire.....	1	.....	.....	.....	.....	.....	1,040	1,040	65
New Jersey.....	3	.....	.....	.....	.....	.....	3,080	3,080	900
New York.....	14	.....	.....	.....	.....	.....	18,750	18,950	4,145
North Carolina.....	6	.....	.....	.....	.....	.....	2,810	3,490	415
Ohio.....	41	.....	.....	.....	.....	.....	40,125	43,185	7,905
Oregon.....	2	.....	.....	.....	.....	.....	175	600	775
Pennsylvania.....	13	.....	.....	.....	.....	.....	15,050	17,082	4,380
South Dakota.....	1	.....	.....	.....	.....	.....	800	800	80
Tennessee.....	8	.....	.....	.....	.....	.....	1,000	2,640	665
Texas.....	7	.....	.....	.....	.....	.....	1,310	3,380	1,100
Utah.....	2	.....	.....	.....	.....	.....	80	800	190
Vermont.....	8	.....	.....	.....	.....	.....	1,600	16,000	2,225
Virginia.....	8	.....	.....	.....	.....	.....	563	2,300	2,863
Washington.....	6	.....	.....	.....	.....	.....	1,350	6,450	1,565
West Virginia.....	1	.....	.....	.....	.....	.....	470	.....	500
Wisconsin.....	4	.....	.....	.....	.....	.....	100	3,400	350
Totals.....	333	2,5926	443	418	2,6087	5,9248	312,105	371,480	67,740

States will doubtless command the close attention of every one interested in this important industry. The compilation is made from late reports to the editors of The American Electrical Directory from the central station managers, and in detail and aggregates may be

of these joint companies is devoted to work other than electric lighting; indeed, it would be a difficult matter in many cases to separate what is so closely linked together in the records of the companies. However, the number of such stations is comparatively small, so that about \$100,000 will be found a fair estimate of the capital of the average central station. This figure in itself shows the effect of the concentration of electric

* From The American Electrical Directory and Buyers' Manual for 1898, Chicago and New York.

ENGINEERING NOTES.

Cheap and good coal is now being conveyed down the Zambesi River to Chinde. The quality of the coal is described as equal to the best English.

The lightest tubing ever made is of nickel aluminum, and measures 0.086 inch outside diameter with walls 0.0015 inch thick; 3,000 feet of this tubing weigh only one pound avoirdupois.—*Engineer's Gazette*.

Troutwine states the melting point of steel as being 2,370° to 2,500° Fah., and iron as being 3,000° to 3,550° Fah., but Greenwood gives the following temperatures, Fah., approximately, for both iron and steel: Incipient redness, 977; dull red, 1,292; cherry red, 1,652; deep orange, 3,012; white heat, 3,372; dazzling white, 3,732 to 2,912.

The special train by which the government sent the Alaska relief expedition from Jersey City to Seattle made the trip of 3,139 miles in 129 hours, or at a speed of nearly 25 miles per hour across the continent, which is remarkable for freight train speed, says The American Engineer and Car Builder. The Pennsylvania took the train to Chicago and the Chicago, Milwaukee & St. Paul took it to Minneapolis, where it was delivered to the Great Northern for the run to Seattle. There were 38 cars in the train, 19 in each section, and of these 10 were occupied by the Laplanders and 3 were filled with moss, which was to feed the reindeer until their arrival in Alaska.

The first locomotive to turn wheels in Alaska pulled out of Skagway on Wednesday, July 20, with two flat cars loaded with rails. At that time seven miles of the road had been graded and over five miles of track laid. Fifteen hundred men are at work in heavy rock cutting at the summit. Two tunnels and much rock work will be necessary before the summit is crossed. It is expected that the track will reach the summit of the pass by September 20. The road is narrow gauge and is being built by the White Pass & Yukon Railroad Company. According to latest accounts the company was arranging for an extensive celebration in the nature of an excursion of several hundred people over the road on August 10 as far as the track was completed.

The oldest engine in the world is in the possession of the Birmingham Canal Navigations, which was constructed by Boulton & Watt, in the year 1777, the order being entered in the firm's books in that year as a single acting beam engine, with chains at each end of a wood beam, and having the steam cylinder 33 inches in diameter, with a stroke of 8 feet, and erected at a canal company's pumping station at Rolfe Street, Smethwick. During the present year (1898) this remarkable old engine, which has been regularly at work from the time of its erection to the current year, a period of say 120 years, was removed to the canal company's station at Ocker Hill, Tipton, there to be erected and preserved as a relic of what can be done by good management when dealing with machinery of undoubted quality. It is worthy of note that the Birmingham Canal Navigations favored Boulton & Watt, in 1777, with the order for this engine, and in 1898, or 120 years afterward, the company have intrusted the same firm, James Watt & Company, Soho, Smethwick, with the manufacture of two of their modern triple expansion vertical engines, to be erected at the Walsall Pumping Station, having 240 horse power and a pumping capacity of 12,713,000 gallons per day.

The Nilgiri Rack Railway, now being built in India, starts from the Melpapillyam Station on the Madras Railway, says Engineering News. The alignment is nearly straight for 4½ miles to the foot of the hills, at Kulhar Station, with easy curves and a steepest grade of 1 in 40. From Kulhar, which is 1,250 feet above sea level, to Coonor, 5,600 feet elevation, the line rises with a grade of 1 in 12½, with curves as sharp as 328 feet radius and 70 per cent. of the whole line in curve. On this railway there are 35 plate girder bridges of 60 foot span and 44 bridges of shorter span; the Burlar bridge has five 60-foot spans and is 120 feet above the water in the gorge. Most of these bridges are on curves of 328 feet radius and on the steepest grade of 1 in 12½. The rack bars, 10 feet 2½ inches long each, are stamped out of steel. The four tank engines to be used were built by Bezer, Peacock & Company, and weigh 33 tons each, with 13 tons on driving axles, and 10 feet rigid wheel base. Each engine will pull 90 tons on the 1 to 40 grade, and 60 tons on the 1 to 12½ grade, and both engines and cars are fitted with powerful brakes. It is proposed to later carry this line over the hills to the port of Calicut, on the west coast of India, and to make connection with the meter gauge railways to the east.

In a lecture recently delivered at Copenhagen, says The Engineering and Mining Journal, Prof. La Cour communicated some of the results of the numerous experiments in connection with the utilization of the wind's power, which have been carried on by himself over a number of years. He pointed out the fallacy of the opinion that the greatest effect was obtained by horizontally moving wings. The question of the effect of the wind's pressure upon a flat surface is a complicated one, but it has been demonstrated that the suction on the lee side is a very important factor. A mill with sixteen wings had only 1½ times as much power as one with four wings. In measuring the percentage of the power of the wind striking the wings, he arrived at the somewhat startling result of 143.7 per cent. This unexpected conclusion was owing to the above mentioned suction on the lee side of the wind passing between the wings. That the wings should not be plane, but have a bent or a concave shape, was an old established truism; and the shape of the wings has in reality much influence upon the suction caused more especially by the wind, which just passes the edges of the wing. In measuring the percentage of the wind power utilized, the wind passing between the wings was taken into account, and instead of 143.7 per cent. the result was 21 per cent. The absolutely best shape for wings has, however, not yet been ascertained. The most important practical point in connection with windmills is the solution of the problem how best to neutralize the inconveniences caused by the irregularity of the wind. Prof. La Cour has for this purpose constructed an original regulator, called the *kratostate*, by means of which a windmill can be used for working a dynamo.

ELECTRICAL NOTES.

From January 1, 1899, says a daily paper, the Vatican will be lighted throughout by electricity. Preparations for the installation have already been commenced. The motor power will be supplied by water flowing at a quick rate of speed from Lake Bracciano, which lies high up in the mountains 20 miles north of Rome. The Pope is declared to be taking great interest in the work.

Some of the colonies of the European powers possess a more progressive spirit in railway affairs than the mother country, this being especially true of England, and street railway extensions are much hampered in the French cities. The first electric railway in Algiers has been built by the French Thomson-Houston Company and is 4.7 miles in length. There are 18 motor cars in service, each equipped with two G. E. motors specially designed to suit the 3 foot 5½ inch gauge. A partition divides the car into two compartments for two classes of service. There is seating capacity for 20 passengers and standing room for 30 more. The power station contains Corliss engines belted to three 300 k. w. dynamos. The system is operated at a voltage of 500 to 550.—*Street Railway Journal*.

L'Éclairage Electrique states that the cost per kilometer of electrical vehicles at the time trials in Paris was about 0.5 franc, on the basis of a charge of 0.03 franc per k. w. hour, at which it is sold at the Place Clichy secteur station. Each vehicle expended current to the extent of 2½ to 3½ francs' worth on the route of 60 kilometers, the current consumed varying from 9.73 k. w. hours up to nearly 14 k. w. hours in different vehicles. Petroleum vehicles cost very much more. The minimum consumption of petroleum by the Peugeot vehicle was 13 liters per day. Petroleum cannot be bought for less than 0.6 franc per liter. Thus the journey cost would be 7.8 francs, or practically 78 pence for 39 miles, being practically 4 cents per mile—an amount heavy enough for two persons, being equal to a third class railway fare. The expense in repairs, etc., of the electric accumulators has been given as 3 francs per day per vehicle. Added to the cost of the energy, this implies a cost of about 6 francs as against 7.8 for petroleum.

In a recent article in Cassier's Magazine Lieut. R. C. Smith, of the United States navy, argues that the battleship cannot implicitly rely on its searchlights to detect torpedo boats in time to sink them in case of night attack. He cites some interesting figures. In twenty-five different exercises that have taken place between the torpedo boats stationed at the United States torpedo station and searchlights ashore, or in ships of the navy afloat, the average distance of discovery by the aid of the light was 781 yards, the greatest distance 2,000 yards, and the least practically zero, the boat having got alongside the ship without discovery. The weather during these exercises was generally good, never with any appreciable fog or mist, and occasionally with a full moon. Other sets of figures were obtained by causing the boats to run out under the searchlight to the limit of visibility. The distance under these circumstances varied from 1,000 to 2,750 yards. The difference is due to the great difficulty of picking up a small narrow-tinted object by a sweeping beam. "Now," says Lieut. Smith, "taking the average distance of discovery, as above stated, at 781 yards, in order to reach torpedo range of 500 yards, the boat must cross a zone of 281 yards, which at the moderate torpedo boat speed of 20 knots would require 25 seconds. Is this sufficient to put the boat out of action? If not, the chances of a single boat against a single ship depending only on searchlights would be more than one-half. With several boats making a preconcerted attack, the chances of the ship would be correspondingly less."

At a meeting of the Physical Society held recently, Prof. Carus-Wilson exhibited an apparatus to illustrate the action of two electric motors, coupled in such a way as to admit of their rotating at different speeds, says The Engineer. The two shafts are placed in a line, and each is fitted with a bevel wheel, gearing into an intermediate wheel. The axis of the intermediate wheel is at right angles to the line of the motor shafts, and is free to rotate in a plane at right angles to that line. The motors can be made to rotate at different speeds by altering the strength of the magnets of either or both. The motion of the intermediate wheel depends upon the difference of the two speeds, or upon their mean, according to their relative directions of rotation. A simple graphic construction enables the action to be predetermined for any given load on the intermediate wheel. Calling the two motors A and B, and the intermediate wheel C, lines can be drawn on a base of current to represent the speeds and the torques for each motor. If the motions of A and B are in the same direction, the load or torque is the same on each, and of similar sign. Hence, as the load on the wheel C is increased, the speeds of A and B tend to become equal. If A had been running faster than B, and for a certain load on C, the speeds of A and B will be equal. If the load on C is further increased, B will run faster than A; also, there will be a certain value for the load on C at which the motion of A will reverse. A further increase of the load on C will bring C to rest. A and B then rotating at equal speeds in opposite directions. When the load on C is nothing, let the motors rotate in opposite directions, A running faster than B. The motion of C now depends upon the difference of speeds of A and B. When a load is put on C the motion of A is retarded, while that of B is assisted; hence B takes less current and A takes more. The torques on the two motors, due to the load on C, are now of equal amount, but of opposite sign. As the load on C is increased the speed of A is reduced and that of B increased, until the two are equal and C comes to rest. B is now acting as a generator, and sending current into A. If the load on C is simply that due to friction, the process cannot be carried further; but if the load on C is reversed, the speed of B becomes greater than that of A, and the motion of C is reversed. In the steering gear designed by the Union Electricitäts Gesellschaft, the intermediate wheel is made to actuate a rudder, by differential action. The motion is reversed by making the speed of one motor greater or less than that of the other.

SELECTED FORMULÆ.

Flavoring Extracts from Others.—

PINEAPPLE.

The characteristic odor of pineapple extract is imparted by butyric ether. The following are typical formulas for these "artificial" extracts:

1. Butyric ether.....	5 parts.
Amyl-butyric ether.....	10 "
Chloroform.....	1 "
Glycerin.....	3 "
Alcohol, enough to make.....	100 "
2. Acetic aldehyde.....	1½ drachms.
Chloroform.....	1½ "
Butyric ether.....	6 "
Amyl butyrate.....	12 "
Glycerin.....	4 "
Deodorized alcohol, enough to make.....	1 pint.
Color yellow with tincture saffron.	

STRAWBERRY.

1. Nitrous ether.....	1 drachm.
Formic ether.....	1 "
Acetic ether.....	5 "
Butyric ether.....	5 "
Amyl butyrate.....	2 "
Amyl acetate.....	3 "

Mix. To prepare an "extract" add enough alcohol with two drachms of glycerin to make one pint. Color red if desired.

2. Butyric ether.....	6 drachms.
Acetic ether.....	6 "
Nitrous ether.....	2½ "
Alcohol, deodorized, enough to make.....	16 ounces.

BANANA.

1. Amyl acetate.....	1 fl. ounce.
Valerianic ether.....	1 fl. drachm.
Diluted alcohol.....	15 fl. ounces.
2. Butyric ether.....	1 "
Amyl acetate.....	1 "
Glycerin.....	4 fl. drachms.
Alcohol, enough to make.....	16 fl. ounces.
3. Essence of pear.....	2 ounces.
Butyric ether.....	2 "
Oil of lemon.....	2½ drachms.
Ethyl benzoate.....	½ ounce.
Tincture of orris, enough to make.....	1 gallon.

Mix and filter.

PEAR.

1. Acetic ether.....	5 fl. drachms.
Amyl acetate.....	2 "
Glycerin.....	2 "
Alcohol, deodorized, enough to make.....	16 fl. ounces.
2. Acetic ether.....	5 parts.
Amyl acetic ether.....	2 "
Butyric ether.....	1 "
Glycerin.....	2 "
Rectified spirit.....	100 "
Color with saffron.	

GRENADINE.

Oil orange.....	1 ounce.
Cinnamic ether.....	2 "
Butyric ether.....	2 "
Essence vanilla.....	12 "
Water.....	1 pint.
Rectified spirit, enough to make.....	1 gallon.

ORANGE (KLETZINISKY).

Tartaric acid.....	1 part.
Aldehyde.....	2 "
Chloroform.....	2 "
Acetic ether.....	5 "
Amyl acetic ether.....	1 "
Benzoic ether.....	1 "
Butyric ether.....	1 "
Formic ether.....	1 "
Methyl-salicylic ether.....	1 "
Glycerin.....	10 "
Oil orange.....	10 "

Mix, filter, and color with saffron.

—Pharmaceutical Era.

Gelatine Mould.—A good gelatine mould may be made in the following manner: Soak the best white glue in cold water for twenty-four hours, then drain off all the water. Melt the soaked glue in a water jacketed kettle, then pour the glue upon the object, the latter being incased in a lead or pasteboard box. Let it cool for twelve hours, then separate the cast from the object. If the object is a statuette, a thread should be attached to the back and extended out of the mould at both ends, so that it may be used for cutting open the mould after it is cooled, to permit of taking out the statuette. A good material for a mould is made in the following way: Dissolve 20 parts of fine gelatine in 100 parts of hot water, and add ½ part of tannin and the same amount of rock candy. It is said that a mould made of gelatine or glue alone may be made more durable by pouring over it a solution of bichromate of potash in water, 1 part of bichromate to 10 parts of water, and afterward exposing it to sunlight. Most objects require oiling slightly before being covered with glue or gelatine.

Government Whitewash.—The following coating for rough brick walls is used by the United States government for painting lighthouses, and it effectually prevents moisture from striking through: Take of fresh Rosendale cement, 3 parts, and of clean, fine sand, 1 part; mix with fresh water thoroughly. This gives a gray or granite color, dark or light, according to the color of the cement. If brick color is desired, add enough Venetian red to the mixture to produce the color. If a very light color is desired, lime may be used with the cement and sand. Care must be taken to have all the ingredients well mixed together. In applying the wash, the wall must be wet with clean, fresh water; then follow immediately with the cement wash. This prevents the bricks from absorbing the water from the wash too rapidly, and gives time for the cement to set. The wash must be well stirred during the application. The mixture is to be made as thick as can be applied conveniently with a whitewash brush. It is admirably suited for brick work, fences, etc., but it cannot be used to advantage over paint or whitewash.

GENERAL BLANCO.

GEN. BLANCO was born in San Sebastián in 1833, and began his military career in the Barcelona affair of 1855. He was promoted to a captaincy in 1858, and voluntarily went to Cuba. There he was ordered to proceed to Santo Domingo, and to inquire into the designs of Gen. Santana. For his services in the campaign which followed, he was promoted to the rank of lieutenant-colonel.

He was next sent to the Philippines, and for some

On October 10, Sagasta appointed him Captain-General of Cuba, to succeed Gen. Weyler. It is now stated that he will resign and leave Cuba before the American forces occupy it.

Our engraving has been taken from L'Illustration.

EXPORTS OF GERMAN ANILINE COLORS.

THE German chemical industry has largely increased its transatlantic exportations during the last few

ed only to 6,975 tons, while in 1897 it reached 17,639 tons. The quantity exported in 1897 was therefore two and one-half times that of 1889, while the value was far from being doubled. German aniline colors have, indeed, conquered the whole world; they are to be found in every country of the globe.

The heaviest consumer is America. The United States imported last year 39,008 double centners* of aniline colors; Great Britain's imports rose to 35,750 double centners; Austria-Hungary bought 16,595 double centners; China, 13,855 double centners; Japan,



RAMÓN BLANCO Y ERENAS, GOVERNOR-GENERAL OF CUBA.

time was governor of Mindanao. Returning to Spain, he served with much honor in the armies of the North and of Cataluña, obtaining several promotions for his services. The principal battles in which he has fought are those of Puente la Reina, Montejurra, Valabiet, Somorrostro, San Pedro Abanto, Monte Muri, the capture of Daucharinea, and the assault on Peña-Plata. The last named engagement procured for him his title of Marquis of Peña-Plata. Before this he had been made a lieutenant-general, on bringing Cataluña to terms.

years. In 1889, German chemicals sent abroad were valued at \$53,800,000. In 1896, they were worth \$77,150,000, an increase of nearly \$24,000,000, or more than 43 per cent., within seven years.

One-third of the total increase is due to the heavy exportation of German aniline colors. They rose from \$9,140,000 in 1889 to \$15,947,000 in 1897, the imports remaining stationary at about \$905,000. This result is all the more remarkable because it was achieved, as in almost every other case, in spite of lower prices; for in 1889, the weight of the aniline colors exported amount-

5,077 double centners; Belgium, 8,284 double centners; British East Indies, 8,066 double centners; and Italy, 9,823 double centners. France, Denmark, Holland, Russia, Sweden, and Switzerland are also good customers for German aniline colors, and Greece, Norway, Portugal, Roumania, Spain, Turkey, Brazil, Canada, Mexico, and British Australia buy their aniline colors in the German market. That the consumption of this

* The double centner, or double German hundredweight, is equivalent to 100 kilogrammes, or 220 46 pounds.

article is largely increasing in Germany itself is shown by the falling off in the consumption of indigo, which is imported from abroad.

THE HOLSTEN THOR IN LÜBECK.

LÜBECK, the former capital of the powerful Hanseatic League, still bears the stamp of its former greatness and importance. Any one who wishes to form a vivid impression of the power attained by German merchants through their commercial league, their statesmanship, and their skill in the art of war in the middle ages, should visit Lübeck. The simple, tall spires, the severity of which is not softened in the least by the smallest ornament; the high church domes, which rise above the steep gables of the houses, the remains of old walls, broad moats, strong bastions, and the colossal city gates—all crowded together on a ridge nearly a mile long—give an impression of centralized, organized power which will be enhanced by going from the station to the city through the great Hol-

AMERICAN COMPETITION FROM AN ENGLISH STANDPOINT.

LAST week we placed before our readers certain statements of fact, inference, and assumption concerning the present and prospective competition of the United States with the United Kingdom.

It cannot, we think, well escape our readers that we appear to be threatened with more or less violent, audacious, and unscrupulous competition all over the world by the manufacturers of all nations. It is matter for regret that those who write on the subject take, for the most part, the pessimist's view of the situation. In this way harm is done. Nothing is to be gained and a great deal may be lost by denunciation of British methods of manufacture and trade, which are at once unreasoning and unreasonable, while they tend to divert attention from the really important facts. If English people could be persuaded that they have been wholly wrong, entirely foolish, in their methods hitherto, the next step, we fear, would be, perhaps, into the region of despair. The final recognition of the fact

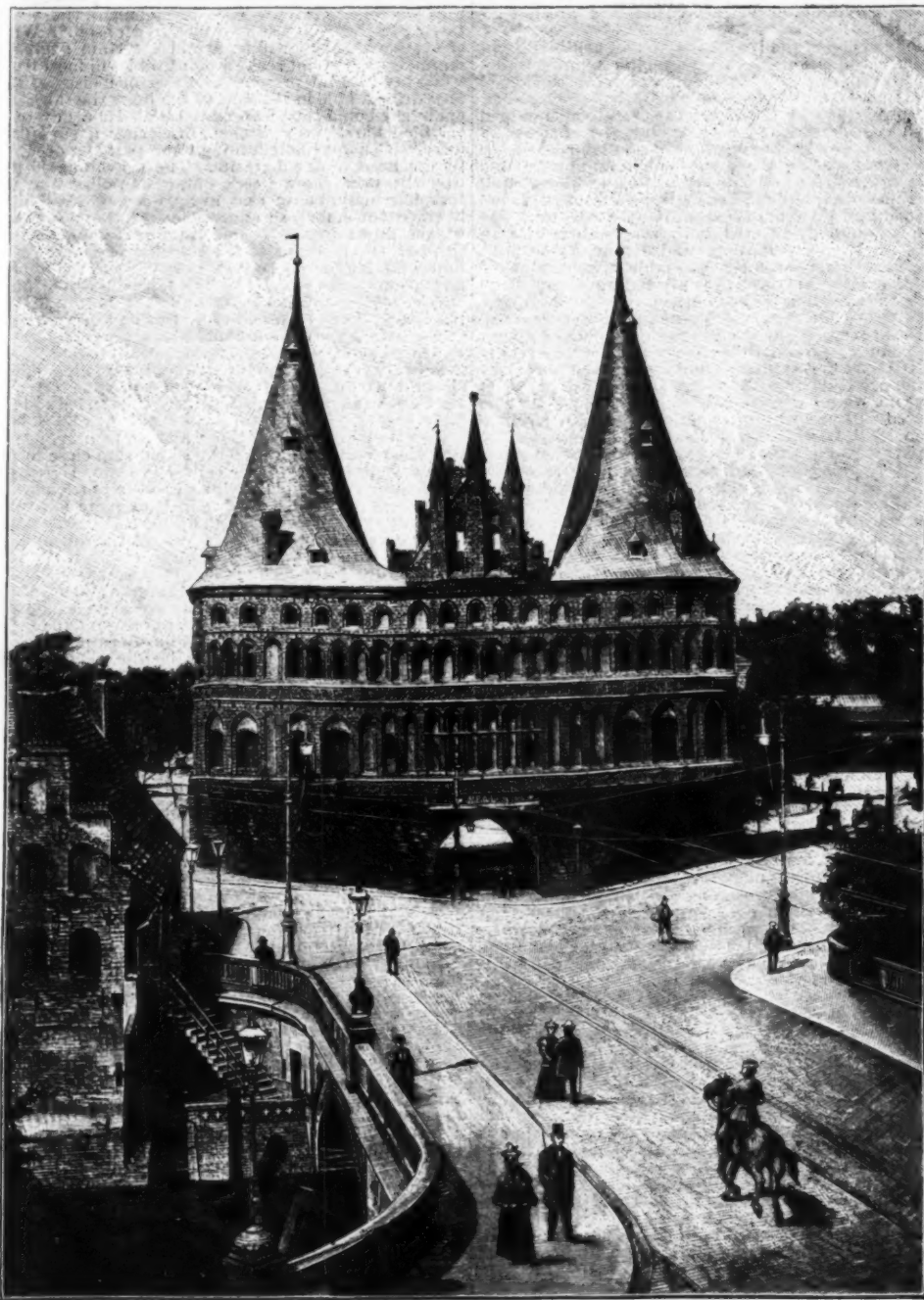
that nothing short of a famine here could have secured a market for it. After food came various other commodities, too numerous to mention. All these we have taken and paid for, and asked for more. But in these latter days we are threatened with importations of iron and steel and coal, for which we have not asked. Now our good friends at the other side of the Atlantic are very far from professing to give us these things. We have to buy them and pay for them. How do we pay for them? This is the crucial question. Unless we can pay for them in goods, we cannot pay for them at all, save on one assumption, to which we shall come in a moment. We must pay either in goods or gold; and it is a patent fact that we cannot pay in the precious metal for the simple reason that we have not got enough of it.

When these truths are stated, we are always told that we have enormous sums invested in the United States, and that the imported articles represent the interest on these British investments. We do not care to dispute the soundness of this contention. But it ensues that an increase in the import of American goods must represent a corresponding increase in the investment of British capital in American undertakings. Can we, under the circumstances, say that the increase of American trade with this country is disastrous or even objectionable? The worst that can happen is the injury of some specific industry. Thus, for example, American clocks killed the English clock-making trade. Individuals may suffer, but the community as a whole will not. Indeed, the people of Great Britain are better off in a hundred ways because of foreign competition with our own manufacturers than they would have been had they depended on the supply of their wants by their own countrymen. We hold, then, that there is no reason why we should feel alarm because Americans push the sale of their wares in this country.

Next we have to consider American competition abroad. This is quite another matter. Competition of that kind may attain very dangerous proportions. It may be shown that for every man employed in the United States, a man must stand idle in this country. This argument is not strictly accurate, but in a rough and ready way it serves to illustrate what foreign competition means. It may be admitted as a rule of trade that no thought whatever is taken of the consumer, or of what may most conduce to his welfare. A Chinaman, for example, is someone to whom something may be sold; and he is the best trader that effects the sale. According to the consular theory, we have here the whole essence of foreign competition in a nutshell. Of several competitors, he who is the best salesman wins. Although the proposition needs qualification, there is so much of truth in it that something will be gained by keeping it before our eyes. The questions involved in the conduct of trade with other nations are very intricate, and they are easily muddled up in such a way that the main issue is lost to sight. We have from time to time brought to the notice of our readers the reports of our consuls abroad. These gentlemen all tell the same story. They insist that the Briton is the worst salesman conceivable. We need not go over old ground. It suffices to state the bald fact that our consuls, mostly shrewd men, maintain that we take no pains to sell our goods. That we try to force on people what they do not want. That we do not speak foreign languages. That we issue incomprehensible catalogues; and so on.

Now, we do not think this is all true. Possibly it is half true, and that half is a great deal too much. The worst of the whole matter is, however, that we fail to detect any evidence that the British manufacturer is taking any steps to improve matters. There is a reason for this, and the reason is at once curious and interesting. The English manufacturer does not change his methods of selling, because he can just now sell everything that he can make, as fast as he is permitted to make it, and he could sell more if he had it to sell. If, for example, half a dozen large boilers are needed, it will be found quite impossible to place the order for prompt delivery with any firm of repute. Heavy orders for locomotives have recently gone abroad simply because the locomotive shops in this country are running overtime and cannot execute more orders. A dozen cases of the same kind might be cited. Under the circumstances, it would be very remarkable if the British manufacturer went out of his way to get orders which he cannot execute, or sell goods which he cannot deliver. This is all very bad policy, because the manufacturer should bear in mind that bad times prevail as well as moments of exceptional prosperity; and nothing can be lost, while much may be gained, by improving in every conceivable way not only our methods of production, but our methods of selling what we produce. The two things are no doubt intimately related; but for the moment we prefer to keep the issue before us as clear of complication as possible, and so we hasten back to the original proposition, that the nation which turns out the best salesmen will do most business. It may be admitted that the Briton is the worst salesman in the world. The reason, we repeat, is that there is no sufficient stimulus felt by the country at large to secure improvement. By "salesman" we do not mean the commercial traveler; he is little more than an incident. Broadly put, John Bull is a bad salesman; and, as we have said, the fact is so because, for the most part, John Bull can sell, without troubling himself, all that he makes. To do a better trade he ought to produce more goods. This, however, is what a most influential body of men work very hard indeed to prevent. Anything like overproduction is carefully and expensively repressed by the trade unions.

In our last impression we showed why it was that the American manufacturer possessed special advantages as compared with the British manufacturer. Most potent among these is the free hand as regards labor which the capitalist possesses at the other side of the Atlantic. Certain more or less valuable branches of trade have been lost to us by the action of trades unions; herein lies our greatest danger. It is quite possible for the English manufacturers to send out travelers and appoint agents in all the markets of the world, who will be in all respects the best salesmen in existence. That is a mere question of terms, education, and selection. But it is quite another matter as regards production. The British workman has something to sell as well as the manufacturer, namely, labor; and we have no hesitation in saying that he is the worst salesman in the world. Who can doubt that is the case, with the record of the Amalgamated



THE HOLSTEN THOR IN LÜBECK.

sten Thor, one of the gates of the city, which is shown in the accompanying engraving. This was begun about the middle of the fifteenth century, completed in 1477 and restored in 1871, and is a fine specimen of the gates which were built in the middle ages for purposes of defense. Three stories, each lower than the other, are raised on a very solid foundation, each of which is provided with numerous windows and loopholes. Between the two towers is a gable, across which run three slender ornamental towers, the central one of which once contained the tocsin. This powerful structure, which is large enough to accommodate a good sized garrison with their arms, formerly protected the rich commercial city from a surprise on the land side and guarded the Holsten Bridge, which crosses the Trave directly back of it. Although no longer needed, the Holsten Thor is one of the most remarkable and picturesque structures in Lübeck, and, in fact, in Germany. Holstenstrasse leads directly from this gate to the market place, with its celebrated Rathaus and the cathedral, which, like the Holsten Thor, constitute a typical embodiment of the old Hanseatic splendor.—Das Buch für Alle.

that he was beaten out of the world's markets would lead the manufacturer to realize as much as he could of his remaining wealth and seek to end his days in peace and quietness. Luckily, there is no reason to apprehend any such dire termination to the war of competition now being waged. Indeed, the danger lies in quite another direction. The British manufacturer may feel too confident, and so find himself worsted when he least expects so undesirable an event.

Let us consider what American competition means, and how it has been called into existence. In the first place, then, we have that form of competition which consists in supplying the people of this country with commodities. Competition of this kind has been going on for many years. It may be said to have begun with the importation of the first cargo of maize, which reached this country about the year 1847. It was imported by a Belfast linen manufacturer to supply food to the starving people of Ireland. From that day to this corn has been poured into this country from the United States. Salt pork began to find its way across the Atlantic about the same time. It was so desperately bad

Engineers' strike of last year before him? The colliers' strike in South Wales doubly reinforces the soundness of our proposition.

Our readers may take our word for it that competition is not only a question of the relative merits of commercial travelers or catalogues. It embodies matters of much greater weight. We last week endeavored to put the facts before our readers. If we are to keep our position in the markets of the world, we must not suffer ourselves to be undersold—our prices must be satisfactory as well as our wares. All good salesmen consider the state of the market. The danger of American competition lies in the fact that they can probably sell what other nations want for less money than we can. The development of the trade of the United States is very largely due to the enormous investment of British capital in that country. In this country, notwithstanding our prosperity, very moderate sums indeed by comparison are being invested in the construction of plant or buildings for manufacturing purposes. In the United States, on the other hand, capital is available in abundance for the development of national industries. In this, and in cognate facts of trade, lies the true danger of this country. We do not think it is a pressing danger, or one which will affect the nation in the immediate future. But it is one to reckon with. We must not throw away a chance; we must not be too proud to take lessons from our rivals. This is not the place to enter into particulars. They are not appropriate in a discussion of principles; but we may at least suggest that considerable amount of capital might be invested to great advantage in many of our engineering shops in the purchase of new tools. It is impossible, we regret to say, to go through most shops of the kind in this country without finding a more or less large proportion of tools which are only fit for the scrap heap. Curiously enough, there is nothing which an engineer grudges so much as money spent on the machine tools which are, so to speak, the very life blood of his establishment.—The Engineer.

SOME FORMS OF FILARIE.

By Dr. G. ARCHIE STOCKWELL.

THE genus *Filaria* seems to have generally served as a classification refuge for all forms of strange, undetermined or unrecognized nematode worms. Properly, it should include only those possessed of thread-like bodies, smooth or finely striated transversely, with simple round or triangular mouths, the oral aperture surrounded by a variable number of papillae. The head is continuous with the body in all cases; the fundamen- terminable or nearly so; tail obtuse, bluntly pointed or slightly expanded; the male organ of sex a long spiculum, often accompanied by a short accessory piece.

Altogether more than a score species have, at different times, been enumerated, but the general lack of exact zoological knowledge on the part of medical observers has led to an almost inextricable jumble. Some of the species announced are now known to be spurious, having been derived from immature specimens. Some are now, most properly, relegated to other genera, notably *Strongylus*; and some are old and distinct forms rebaptized by ignorance—for example: *Filaria Bancrofti* is only the adult form of the nematode, formerly known as *F. nocturna*, which in turn has been confounded with the *F. sanguinis hominis*. The most prominent and notable of the genus, both to physicians and naturalists, aside from the foregoing, are *F. loa* or conjunctiva, also described as *F. lentis*, *F. guineensis*, or *medinensis*—which for years has been a shuttlecock between *Filaria* and *Dranunculus*—and the new form discovered by Daniels.

A comparatively common disease in the Orient, and one that often carries no small suffering in its train, is due to the *Filaria sanguinis hominis*, or nematode that, as its name indicates, infests the circulation; the same or a kindred form attacks animals as well as man, and has especially been noted in the blood currents of dogs and other Canidae. In Ceylon and hither and farther India, the filarial disease is frequently encountered. The hospitals at Kandy, Trincomali, Trincompholy, and Madras are rarely without one or more cases in their wards, either awaiting, undergoing, or convalescing after a system of palliative treatment. Neither is the disease unknown to Calcutta, Bombay, and even more northern localities.

Many queer tales obtain, mostly gratuitous, regarding the habits of life and the modes whereby this *Filaria* gains entrance to the human economy, and the most plausible and definite yet lack authentic verification. The mosquito and its larva have been accused of being intermediaries, apparently with some reason; yet it should not be forgotten that this little pest in its varied forms has been putatively cited as the direct agent in disseminating a number of maladies, including malaria, yellow fever, beri-beri, some forms of dysentery, leprosy, liver-flukes, and dracontiasis (Guinea worm disease)—the evidence regarding all being far from conclusive. Dr. Manson* believes the embryonic *Filaria sanguinis* are taken into the stomach of the mosquito with the blood of persons infected by the hamat-zoon, the further development of which shortly begins within this insect; thence they are transferred to water, whence it is assumed they again find entrance into the body of man. Also that the embryos, deposited in water, enter the larval form of the mosquito, and that the latter is taken into the human stomach inadvertently, only to find its way ultimately into the circulation. Unfortunately, neither of these assumptions is wholly satisfactory, though it must be admitted Dr. Manson has in many ways added materially to the life histories of nematodes.

Another tale concerning this *Filaria* is probably derived from observation of a species peculiar to the West Indies, Spanish Main, Brazil, and Dutch, French, and British Guiana, known as *F. Bancrofti*, but formerly specifically designated as "*nocturna*," and confounded with *F. sanguinis hominis*. It is to the effect, the presence of the creature can be detected only when its host is asleep, as it only at such times comes to the surface of the body, infesting the capillary circulation. Needless to say, perhaps, this is pure rubbish, as are also the accounts of studying the creature in the daytime in patients in whom sleep has been artificially induced. The *F. Bancrofti*, however, does ap-

pear in the more minute and superficial capillaries at night, when, of course, the body of the host is in a perfect condition of repose, and simply because, at such time, the pressure of the blood current is reduced, admitting of more free movement.

Oftentimes the members of blood *filaria* remain so inconsiderable their presence is not even suspected; but on the other hand, the infection may be so great as to constitute a troublesome malady, one that, while it may in some measure be mitigated, is practically, if not wholly, ineradicable.

After long trial and experience, in the Madras General Hospital, definite rules have been promulgated for the surgical treatment of the malady, for only to this branch of medicine is it at all amenable; and even then, as already intimated, it is less the disease itself that receives attention than certain sequelae dependent thereupon, such as glandular enlargements and lymphangitis (blocking of lymph channels); and these, for the most part, resolve themselves into lymph serotum, filarial hydrocele, elephantiasis, and abscesses occurring in the course of the lymphatic vessels where dead and parent worms lie embedded.

In these cases, though, the trouble is due to interference with the flow of lymph, inasmuch as the glands and main lymphatic vessels themselves are not affected.

The blocking of the lymphatic system exhibits itself, in part, in dilation of the lymphatic trunks, which contain a pinkish, milky fluid, and have thickened walls. These dilations usually occur in the neighborhood of glands, and on careful dissection, enlarged lymph vessels are found passing into, and others passing from these to other dilations or to glands close by; and accompanying these are enlarged glands, due either to thickening of their tissue and proliferation of the numerous lymphoid cells they contain, or to enlargements of the lymph spaces in their structure. The groin is commonly affected, both the femoral and inguinal regions participating, and frequently on both sides. Also it is extremely probable that the pelvic and other internal lymphatics are enlarged, especially where the affection is symmetrical.

The treatment, as already suggested, has resolved itself into excision of the enlarged and inflamed glands and nodules, careful dissection being, of course, demanded. At first sight it might appear as if such procedure, particularly when undertaken in the region of the groin, would afford only temporary relief, and be followed within a very brief period of time by a return of the local trouble in all its original severity. But this is not true; it requires years for these local manifestations to develop, and recurrences are practically unknown. It is the dead parent worms, which are often three-fourths to an inch long, or longer, that become encysted, hence the difficulties encountered in attempting to determine their presence for the purpose of examination or diagnosis. The immature or embryonic *filarie* are, of course, microscopic.

The *Filaria Guineensis* is a long, slender worm, very like a horse hair, that sometimes attains a length of a yard, four feet, or more, its diameter never exceeding one-twelfth of an inch. Formerly held to be indigenous to the Guinea coast of Africa, it is now known to also exist on many portions of the east coast, including Zanzibar, Abyssinia, and Upper Egypt; also in the Philippines and other islands of the East Indies; in Tonquin, Anam, hither and farther India, Arabia Petrea, vicinities of the Caspian Sea and Persian Gulf, Venezuela, the northern coasts of South America, east of the Isthmus of Darien, and many of the West Indian islands, more especially Trinidad and Curacao. There are many who believe this is the species spoken of by Plutarch, in the eighth book of his "Symposium," wherein he quotes Agatharchidas as saying that people taken ill on the shores of the Red Sea suffer from many strange and unheard of maladies, among others, a form of worm, literally "little snakes" (*ἰσχυρὰ ὄφεις*), which come out of them, gnaw away their legs and arms, producing foul, festering sores, but when touched, retract themselves into the muscles and there give rise to most unsupportable pains. If this is true—and the foregoing is certainly in a measure descriptive, as will be seen later on—it is not difficult to accept the explanation that it was to this Guinea worm that Moses referred, when relating the afflictions of the Children of Israel in the vicinity of the Red Sea through "fiery serpents."

The female Guinea worm, which is always the creature troublesome to man, presents the form of a double tube—one tubular sheath, as it were, inclosing another—the inner constituting the oviduct, or, to speak more correctly, it represents the uterus and entire reproductive tract. The creature is viviparous, and the myriads of embryos lie within the oviduct, coiled after the manner of trichine, the tip of the tail alone, perhaps, projecting.

The male, if it has ever been identified—which admits of considerable doubt—is of exceedingly minute proportions, perhaps less than half an inch in length. It is probable the female, also, is small at the time she gains entrance to the human economy, but she has also previously become impregnated, and her subsequent development is a sequel to her parasitic existence. It seems absolutely essential to the reproduction of her kind that she invoke some other form of life as an intermediary, and this may be horse, dog, or ox, as well as man. There is apparently no preference of any kind, though it must be admitted, so far as man is concerned, the dark and yellow races suffer more than the white, probably because the former afford greater opportunities for infection.

Exactly how infection takes place is unknown. Formerly it was believed the female, from her residence in fresh water of natural or stagnant pools, in damp mould or mud of low-lying marshy districts, or the soft, ochreous, argillaceous clayey soil that in many tropical localities forms the sides of ponds, tanks, and other artificial reservoirs, seized an opportunity to forcibly insert herself into the tissues of the foot, ankle, or leg, since these are the situations in which she is most generally found, and are, moreover, most suitable to her purpose. Latterly, however, it has been suggested entrance was had in the same precise way as claimed for the *F. sanguinis*, viz., through the ingestion of water in which the worm, in its minute form, is concealed, and that it subsequently makes its way to those tissues best adapted for its development and subsequent extension of embryos into moist or wet sur-

roundings; here, too, the ubiquitous mosquito has been charged with being an intermediary—a charge that must be taken exclusively cum grano. The fact remains, however, that a long time may elapse between infection and the full development of the parent worm, which necessarily adds to the difficulties of determining how the infection takes place; and from ten to twelve, or perhaps even fifteen months are required for the complete development of the embryos from the impregnated ova, depending somewhat, doubtless, upon the surroundings—shifting temperatures, etc.—affecting the parent. But the ankle or leg is by no means always the site of the parasite; it has been found in the muscles of the neck and back, of the arms, of the thigh, in the buttocks, in the groin, and in the muscles of the chest. Moreover, it is not permanent as to situation, and migrates, as do most *filarie*, with the greatest facility. Ewart saw one change from the upper part of the lateral aspect of the thorax to the groin in the course of twenty-four hours; and in the same period of time one was observed by the writer to migrate from the upper third of the outer portion of the thigh to the instep.

Although Fedchenko found that the embryo on leaving the parent (and her host) enters the body of a cyclops wherein it undergoes development, the actual tracing of this fact was left for Dr. Manson.* When the embryos in the oviduct attain a certain degree of maturity the parent seeks a point that will most likely bring her into the presence of water or moisture. She now drills a hole in the skin of the host, the subjacent epidermis being raised up as a bleb. In a day or so the bleb bursts or is broken, disclosing a superficial ulcer, with a little hole leading to or perhaps occupied by the head of the parasite. The prevailing idea is that the worm now creeps out, or is pulled out, and that her body, being cast away, decomposes and so liberates the embryos; another idea is that the worm breaks down in the tissues, and her young escape through the medium of the purulent discharge thus induced. Neither is correct, however, for there is no formation of pus so long as the *filaria* is alive, intact and left alone, and she never quits the host until she has first got rid of her embryos. But let the continuity of the parent worm be broken, liberating the embryos in the tissues, a severe inflammation follows, with ulceration, sloughing, and general breaking down, that is with difficulty overcome, and in some instances has necessitated resort to amputation, even led to fatal gangrene.

On squeezing a little cold water from a sponge so that the stream will fall on the sound skin close to the Guinea worm ulcer, in the course of a few seconds it will be observed a delicate little tube—a portion of the oviduct—is protruded for an inch or more and then suddenly ruptured, releasing a droplet of whitish fluid; or the droplet may come from the central opening in the ulcer without any visible protrusion. If the protruding tube is touched with any warm, dry substance, it is at once withdrawn; hence Plutarch's description. If the droplet of fluid is now collected upon a slide and placed under the microscope, it will be found to harbor hundreds of coiled, apparently dead embryos that, however, when a little water is instilled beneath the cover glass, at once wake up, stretch themselves, move, and in a short time are swimming vigorously. About fourteen days are required for the parent to thus intermittently empty her oviduct of the millions of embryos; but once all are expelled, she begins to come out herself, and can now more readily be forcibly withdrawn than at any other time. It is worthy of note also, inasmuch as the parent is not possessed of a vagina, the oviduct with contained embryos are extended through the mouth; and when the last of the latter have been expelled, the remaining portion of the reproductive tube is got rid of the same way. The contractions of the musculo-cutaneous wall, in response to the stimulus of water applied to the skin of the host, causes the oviduct to prolapse through the mouth. It is probable, reasoning from analogy, that the subsequent life of the female worm is exceedingly brief.

Manifestly the chief object of the parent is to secure the best possible opportunity for her offspring to reach water and thus secure an intermediary host for subsequent development; this host is usually the minute fresh water crustacean known as *Cyclops quadricornis*. Manson overnight placed embryos together with a number of *Cyclops* in a watch glass, and on inspecting under a microscope the following morning, was rewarded by finding every one of the latter had some ten or twenty *filaria* embryos coiled up or wriggling about in its body. Subsequently it was discovered the embryos did not enter the host by way of the alimentary canal, as Fedchenko surmised, but by penetrating the armor of *Cyclops* by attacking it between the joints of the ventral plates. It was also discovered that soon after the embryo enters the *Cyclops* it changes its shape. When a free swimming creature the body of the former is flattened from side to side, something like a very much elongated flounder; but soon after it enters the *Cyclops* it assumes a cylindrical form, and after a variable time casts its transversely striated skin, along with its slender swimming tail, a short, conically shaped, pointed cauda—sometimes it is but a mere stump—taking the place of the latter. Later it moults again, and now a tripartite tail obtains. Simultaneously with these changes the creature increases its size, its alimentary canal undergoing considerable development, and becoming filled posteriorly with brown granular material.

One notable feature of Dr. Manson's researches indicates that the usual method of getting rid of the Guinea worm by progressive windings—for, old as this procedure is, no better has ever been developed—is wrong, unless the embryos have been first expelled. He assumes the accidents that accrue to this procedure are generally due to ignorance of this physiological phenomenon and neglect of its teachings.

Filaria Loa is found only under the conjunctiva of the eye, where it appears as a small ridge, and has been assumed to occur only in the negro race; but the falsity of the latter has, within a few years, been exhibited by its occurrence among pure whites. It is a peculiar African product, and when observed elsewhere has been proved to have originated in the "Dark Continent." Probably its mode of propagation is similar to that of other *filarie*, but of its life history next

* Aitken's Practice of Medicine, vol. I., 7th ed.

* The Lancet (London), vol. II., 1896.

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to nothing is known. Seldom is more than one found, though a few instances are recorded where each eye exhibited a parasite. No filaria have ever been observed in the blood where this form was present; hence it is assumed its mode of entrance into its host is peculiar and yet to be discovered. It is about twenty-five millimeters long, has a slightly tapered head, the tail still more tapered, and it looks more like a piece of fishing gut than anything else; around the body is wound spirally a fine filament generally assumed to be the alimentary canal, but more likely is the oviduct. After a certain time, said to be about seven years, it is supposed to voluntarily quit its host, but this seems to have no better basis than fanciful conjecture. The swelling it causes sometimes simulates a small varicose vein and has been mistaken for such, and occasionally is accompanied by intense pain, though as a rule it gives rise to no greater disturbance than a slight itching accompanied, perhaps, by suffusion.

A woman aged thirty-two years was discovered to have a filaria in one eye, the result of residence in the Transvaal, which induced a sensation of pricking or quivering. Its movements were clearly recognizable. The parasite wandered over the eye beneath the conjunctiva, which it raised into a small ridge as it progressed; and, more remarkable, it would sometimes leave one eye and cross over to the other, and its movement over the bridge of the nose could be felt. It finally confined itself exclusively to the left eye, whence it was removed by Argyll Robertson. It was kept in place by the finger of an assistant while the eye was cocainized, then an incision made in the conjunctiva and the parasite withdrawn, which after removal proved to be very active, but quickly succumbed when placed in a weak solution of boric acid.

Another notable feature was that the parasite was frequently visible while its host resided in Africa, but on her return to England it was only to be seen in warm weather, disappearing again into deeper tissues on the least exposure to cold.

Recently a new filaria has been discovered by Dr. C. W. Daniels, of the Colonial Medical Service, British Guiana, which is readily differentiated from the two common forms existing in this region—*F. Bunewfti* and *F. Magalhães*—by its smaller size and lack of papillae about the mouth. It has not yet received specific designation, as its discoverer fancies it may prove to be the parental form of some species already classified, perhaps *F. perstans*. Both males and females have been detected in the upper part of the mesenteric and mesenteric fat, around the pancreas and in subpericardial adipose, but whether it possesses any pathological significance as regards man has not been determined. A notable peculiarity is the possession by the female of two ovarian tubes.

(Continued from SUPPLEMENT, No. 1184, page 18990.)

GLACIAL GEOLOGY IN AMERICA.*

By HERMAN L. FAIRCHILD.

KAMES.—In an historical way it is difficult to discuss kames apart from eskers, as in the literature down to 1881 the several names employed were used quite indifferently, and the two forms of deposits were not discriminated.

Edward Hitchcock, in 1847, evidently described areas of kames under the name of "moraine terrace," and admitted that he was unable to determine their origin.

As stated above (see under eskers), the name was first used discriminatively by McGee in 1881, and Chamberlin, in 1883 and 1884, described them as conical forms, not erosional, as some writers had thought, and grouped them genetically with water-laid drift, peripheral to the ice body and associated with terminal moraines.

As to the precise physical conditions under which kames, kame areas, and kame moraines were formed there is still some uncertainty. That they were deposited by glacial streams in immediate relation to the ice edge is regarded as quite certain. But were they formed on open ground or in standing waters? And were they from subglacial drainage or from streams higher in the ice sheet? The latter question is partly dependent upon the amount of interglacial and superglacial debris. Mr. Upham has favored the latter source of supply, but from the study of the Greenland glaciers, Chamberlin thinks that both kames and eskers are from basal drift and are "products of relatively active, vigorous glaciers." It seems that the existing glaciers of Alaska and Greenland suggest subglacial origin of the kame drift, but it is conceivable that the conditions of the American continental ice sheet may have been different.

In 1884 Prof. Shaler presented an argument for the formation of kames in static water by detritus-buried subglacial streams issuing from the ice front under hydraulic pressure. This theory might explain the majority of kame deposits, which with highly accentuated topography seem more abundant in localities of marine or lacustrine submergence during the ice recession. But mounds of water-laid drift are found at various altitudes, and such were evidently formed under different conditions. It might be well to discriminate here and restrict the word kame to the typical subaqueous deposits and find another term for the subaerial accumulations.

Kettles.—Perhaps less progress has been made in explanation of the hollows or bowls called "kettles" than of any other glacial phenomenon. The explanation of their origin made by Edward Hitchcock, in 1841, that they were produced by the melting of buried masses of ice, is still the common interpretation of their genesis. In 1859 this idea was adopted by Whittlesey in his paper on the "Drift Cavities or Potash Kettles of Wisconsin." In 1877, Prof. Chamberlin mentioned four possible causes of kettles: (1) Irregularities of heaping; (2) the pushing of one drift ridge unconformably against a preceding one; (3) the incorporation of ice blocks; and (4) under-drainage. In 1884, Dana thought the basins in the gravel terraces of the New Haven region were produced by eddies in the flowing water; but these have been examined by J. B. Woodworth, who pronounces them typical ice-block kettles. Those irregular depressions, sometimes of large size, which occur in water-laid drift, suggesting the name "pitted plains," have received no other ac-

ceptable explanation than that of ice-block genesis, although still regarded by many geologists as of uncertain origin.

It seems probable that "kettles" may be of various origin. Some of those in moraine and kame deposits may be due to irregular piling of the drift, while others were most certainly occupied by ice-blocks during the deposition of the drift. Some of those in delta terraces are evidently due to deficient filling by the capricious action of shore and stream currents. The larger and deeper ones in river terraces or in deltas, giving rise to the name "pitted plains," are most probably of ice-block origin.

The literature of the subject is scanty. Among later writers are Mr. Upham and Prof. Woodworth. The latter has endeavored to estimate the size of the ice-blocks from a study of the kettles.

Valley Drift, Terraces.—The enormous quantity of water-laid drift in the stream valleys leading south from the glaciated areas, as well as within those areas, was the firmest basis for the diluvial hypothesis of the drift; and the early literature contains considerable matter upon the subject. Down to 1857 the most voluminous writer was Edward Hitchcock. As early as 1833 he explained the Connecticut River terraces by a down-cutting of the river through beds deposited in higher stages of flood. In his paper of 1857 he recognized the complexity of forces, and thought that the valley terraces were formed in different ways; those of the Connecticut valley chiefly by a slow lifting of the land with local changes or shifting of the streams. The recognition of the valley drift of New England as derived from glacial debris and deposited by glacial floods was made by Dana in 1855. As early as 1858, M. Tuomey suggested that the Mississippi valley drift was deposited by floods from the sudden melting of the northern glaciers, and in 1859 E. B. Andrews correlated the terraces of the southern Ohio valley with the glacial drift.

Concerning details of the terrace formation in New England, there have been divergence and changes of opinion. In the earlier editions of his Manual, Dana held that the terrace drift was accumulated during a time of land depression and slack drainage, and the terraces excavated during pauses in the re-elevation of the land. But in the edition of 1879 he admitted that the height of the upper terraces marked the height of the glacial flood, and that change of land altitude was not essential, thus granting the early contention of Hitchcock.

Loess.—The resemblance of certain superficial deposits throughout the interior portions of the United States to the "loess" of Germany and of China was recognized early in this century, but the writer is not certain of the earliest suggestion of connection of the deposit with glacial phenomena. Such suggestion was made as early, at least, as 1866, by Whittlesey, who attributed the "loess-like" deposits of Illinois, southern Iowa and Missouri to floods from the melting ice sheet. From that date to the present the numerous writers upon the loess have been almost unanimous in regarding the American deposits as aqueous, and as having some relation to glacial conditions, although there were differences of opinion as to the precise conditions of deposition. One notable exception to this view was published in 1879 by R. Pumpelly advocating the eolian origin of much of the Mississippian loess. A paper, by J. E. Todd, before this association in 1878, gave a good summary of the aqueous argument. In 1881 Chamberlin was almost alone in thinking that the loess of Iowa and Nebraska was partially aqueo-glacial and partially eolian, in which opinion others now concur.

During the years 1878-1881 McGee discovered that the Iowa loess was an aqueo-glacial deposit marginal to the drift sheet now named "Iowan." This work was published in 1882. This idea was subsequently amplified and given with more fullness and detail by Chamberlin.

The description by Todd and Bain, in 1895, of six feet of till, supposed to be of iceberg origin, intercalated in the loess of Iowa, would help to confirm the theory of fluviolacustrine origin of at least those deposits.

The latest conclusions upon the subject of the loess are found in two papers of last year, one by J. A. Udden, the other by Prof. Chamberlin, which agree in attributing the Mississippian loess partially to eolian origin. The paper of Mr. Udden argues for the atmospheric origin in larger part. Prof. Chamberlin holds that the loess was originally glacio-aqueous and only secondarily eolian, the latter in minor part; in these respects differing from the Asian loess of Richthofen.

Lake Basins—Preglacial Drainage.—The problem of the origin of lake basins, especially those of the Laurentian system, has been so intimately connected with glacial studies that the subject should be mentioned.

With the extreme views of glacial erosion that were current after the general adoption of the glacial theory of Agassiz it was but natural to attribute even larger lake basins to the gouging erosion of the ice sheet. That such is the genesis of many smaller tarns and lakelets in areas of thin drift is admitted. Geikie states this emphatically for Scotland and Bell for Canada. Twenty years ago Newberry so explained the great lake basins, with Dana assenting somewhat cautiously. As late as 1894 Prof. Tarr thought that the Cayuga basin had been deepened 450 feet by glacial erosion.

On account of the incidental character of the references to this matter, it is doubtful where credit should be given for the earlier suggestions of the current views. As early as 1866 Whittlesey recognized that the preglacial topography of the region of the great lakes was in its broader features the same as at present. This was an important observation and gave a basis for moderate views. In 1881, J. W. Spencer attributed the great lake basins to subaerial and fluvial agencies, and Prof. Claypole the same. The complexity of their origin was emphasized by Prof. Chamberlin in 1883, and this now seems evident.

In 1863 J. P. Lesley attributed the New York lakes, with Erie and Huron, to "northward rise of their floor-rock." This keen inference has been verified by studies of the old shorelines. It is now generally believed that the great lakes occupy preglacial basins of subaerial erosion, modified in some unimportant degree by the mechanical abrasion of the ice; and that the ponding of the water, while possibly due in some ex-

tent to moraine damming, is chiefly due to differential northeastward uplift.

Dr. Newberry, as early as 1862, showed the existence of ancient river channels in the Erie basin buried under glacial debris, and proving the higher altitude of the land in preglacial time. In 1869 he predicted the existence of an undiscovered channel that must have been the preglacial connection of the Huron and Erie basins, and in many subsequent writings he discussed the ancient drainage of North America. Dr. J. W. Spencer subsequently took up this work in the Laurentian basin with good results, and has endeavored to map the preglacial drainage of the great lakes.

The studies of Spencer, Carll, Foshay, I. C. White, Salisbury, Chamberlin, Leverett, and others, indicate that some of the area, now drained southward by the upper Mississippi, Ohio, and Susquehanna, was in preglacial time probably drained northward.

Glacial Lakes.—The glacial phenomena receiving the latest serious study are those of ice-dammed waters. The subject has been found of unusual and romantic interest, and considerable literature has accumulated, chiefly during the last decade.

The necessary existence of lakelets or small ephe-meral bodies of water between the ice foot and north-sloping land surfaces has long been recognized, but it is only in recent years that the conception has been enlarged to grasp lakes of vast extent and duration. The possibility of such lakes has been questioned, but the facts are so numerous, so easily found and verified, and so clear and incontrovertible that doubt is no longer possible.

With the approximate determination of the trend of the retreating ice foot, as shown by the peripheral drift, the history of the glacial waters becomes possible. The study of glacial lakes naturally followed the study of moraines. The two studies are now prosecuted together with advantage, since it is found that shorelines and outlet channels must frequently correlate with moraines.

The conspicuous shoreline phenomena about the Laurentian great lakes were early observed by settlers and travelers, particularly in the basins of Ontario and Erie, and their character as beaches was understood. Lyell, in 1842, regarded them as marine, but the common explanation, and the correct one, attributed them to fresh waters. They were the subject of study and printed description by Thomas Roy (1837), Lyell, Hall, Whittlesey, Newberry, Gilbert, N. H. Winchell, and Klippert, before the true cause of the high waters was understood. Dr. Newberry seems to have been the first one to recognize the ice barrier as the occasion of the high-level waters in the Laurentian basin. As early as 1862 he clearly described the ice-wall of the retreating glacier as forming the northern shore of the fresh-water inland sea and described the consequent phenomena. In 1869 he presented the same facts more definitely and with greater fullness, but apparently he did not yet clearly realize that the ice wall was the dam or barrier which retained the broad waters at the ancient high level, suggesting instead some change in the attitude of the land. However, he did recognize the ice barrier in his first volume on the geology of Ohio, published in 1873; and in the second volume, 1874, he not only clearly predicted the ice dam, but discussed the whole history of the glacial waters, from the early primitive stages, in a manner that shows he had a clear conception of the main facts.

Before this association, in 1872, N. H. Winchell suggested the damming of the Michigan waters upon the north as having made the ancient Chicago outlet effective; also the blockade of the St. Lawrence valley as causing the high-level waters in the Erie basin. The latter suggestion doubtless implied the blocking also of the low divide between the Ontario basin and Mohawk valley, which is far below the old shorelines. In the same year, 1872, Winchell suggested that the waters of the Winnipeg basin (Lake Agassiz) had been forced south, through River Warren, by a glacier barrier. These were probably the earliest definite localization of glacial waters.

The first mapping of ancient beaches, and the correlation of those beaches with an abandoned outlet, was by Mr. Gilbert, in 1871, in description of the Maumee valley beaches and the Fort Wayne outlet. Land deformation he supposed was the cause of the change in water level.

The tracing of the beaches in the Erie basin was done by Gilbert, Winchell, Klippert, and Newberry mostly before 1873. Newberry's map of the beaches west of Cleveland, 1874, is the first map of glacial lake beaches, so recognized.

The earliest systematic work upon the beaches in the Ontario basin was done by J. W. Spencer and published in 1882 with a theory of marine origin. In 1885 Mr. Gilbert printed a description of the high beaches upon the southern side of the Ontario basin and correlated them with an eastward outlet by the Mohawk-Hudson. The names Warren, Algonquin, and Iroquois were applied by Spencer to the ancient high waters of the Erie-Huron and the Ontario basins in 1888, but with denial of their glacial character.

The earliest comprehensive account of the glacial lake history of the Laurentian basin was published by Gilbert in 1890, with maps, which were the earliest cartographic representation of glacial lakes. In this admirable paper he showed the rise of the beaches northeastward, due to the differential uplift of the region; the fluctuation of level in the basins produced by the opening of successively lower outlets toward the north and the progressive tilting of the land throwing back the flow upon southern outlets; with the final result in the present great lakes.

For the full confirmation of the theory of glacial dams it was necessary to prove the actual relation of moraines, as marking locations of the ice barrier, to the beaches. This was first done by Frank Leverett in 1892, in the western section of the Erie basin; and in 1895 in the southeastern section. In 1896 F. B. Taylor correlated the beaches and moraines in southeastern Michigan, thereby finding the key to the glacial lake succession in the Erie-Huron basin. His tracing of subaqueous moraines from highland to highland and their correlation with old outlets and shore lines leave no chance for further doubt of the adequacy of glacier dams.

The largest known glacial lake, and the one most fully described, is Lake Agassiz. The shore line phenomena of this lake were described in part by H. Y.

* Address before the Boston meeting American Association Advancement of Science, Section E.

Hind as early as 1859. The southward outlet to the Mississippi was described by G. K. Warren in 1868. The glacial character of the waters was suggested by N. H. Winchell in 1872 and 1877. The name "Lake Agassiz" was applied by Warren Upham in 1879, who has immortalized the lake and himself by his recent monograph.

Several other investigators have described glacial lake phenomena in different localities: G. H. Cook, in New Jersey, with later description of his "Lake Passaic" by R. D. Salisbury and H. H. Kimmel; E. W. Claypole in Ohio; C. R. Dryer in Indiana; S. P. Baldwin in the Champlain Valley; E. H. Williams Jr., in the upper Lehigh Valley; I. C. White in the Monongahela Valley; the writer in central western New York; and especially F. B. Taylor throughout the larger part of the area of the great lakes.

The glacial lake studies have developed interesting and important results concerning crustal movements. The deformation of the shore lines gives values for the epeirogenic differential uplift over the Laurentian and the Winnipeg basins during postglacial time, of which the full significance may not yet be developed. An interesting problem now in process of solution by Taylor, Gilbert, and others is the relation of glacial lakes in the upper Laurentian basin to the history of the Niagara River and the excavation of the gorge.

EXISTING GLACIERS.

The existence of living glaciers in the United States has been recognized since about 1870, and it is found that in Oregon and Washington are Alpine systems which are in some respects as interesting and instructive as those of Switzerland. The glacier fields of Alaska and adjacent Canada are far superior to those of Europe, and include the only known examples of the "Piedmont" type, of Russell, the broad and comparatively stagnant field, fed by streams of the Alpine type. Excepting the little known and inaccessible Antarctic area, North America possesses, in Greenland, the only existing "continental" glacier.

The first recorded observation of glaciers in the United States was made by members of the Williamson expedition, in 1855, as Dr. Newberry stated, in writing many years later, that some of his party found miniature glaciers at the heads of streams in the group of Oregon Mountains called the Three Sisters; but no description was published. In 1857 Lieut. A. V. Kautz reported the discovery of a living glacier on Mount Rainier. In 1868 E. T. Coleman explored Mount Baker and published in the following year a description including the glaciers. The earliest important study made by trained geologists was upon the glaciers of Mounts Shasta, Hood, and Rainier in 1870, by Clarence King, S. F. Emmons and Arnold Hague.

The first geologist to examine the Alaskan glaciers was W. P. Blake, in 1863, his account being printed in 1867. W. H. Dall and Marcus Baker studied the glaciers of Yukutat Bay in 1874 and named the famous Malaspina glacier. Other explorers were John Muir, 1878, who discovered Glacier Bay and the glacier subsequently named after him; Dall, the second visit, in 1880; C. F. Wright and S. P. Baldwin in 1886; Lieut. Schwatka and William Libbey in 1886, who gave many names to the glaciers about Yakutat and Icy Bays; H. F. Reid and H. P. Cushing in 1890; and I. C. Russell in 1890 and 1891. Prof. Russell discriminated and named the "Piedmont" type of glacier in 1891, from his study of the Malaspina. The Copper River glaciers were noted by Lieut. H. T. Allen in 1887, and were seen by C. W. Hayes and Lieut. Schwatka in 1891.

The Canadian glaciers were first explored in the Selkirk range by Rev. W. S. Green, in 1888.

The Greenland ice foot has long been seen by voyagers, and has been written upon since 1721. The modern study began with Nordenskiöld's first exploration, in 1870, and with Helland's measurements of the ice movement in 1875. The public is familiar with the venture-some trips on the Greenland ice cap by Lieut. Peary in 1886, 1892, 1894, 1895 and the trans-Greenland journey of Nansen in 1886. While adding something to glacial science, the work of these and other explorers was more particularly along lines of geographic and meteorologic science. The close geologic study only began with the work of Chamberlin in 1894. This work has been carried on by Wright, 1894; Salisbury, 1895; Barton and Tarr, 1896.

In the accumulating literature upon the living glaciers of the continent the papers by H. F. Reid and I. C. Russell, relating to the physics and phenomena of Alaskan glaciers, deserve special mention, with those of Prof. Chamberlin descriptive of the structure and behavior of the Greenland ice. Two writings of Prof. Russell of a general or descriptive character bring down to date a summary of our knowledge of the glaciers of the continent; the first on "Existing Glaciers of the United States," 1884, and the second a book of the past year, entitled "Glaciers of North America."

Down to a few years ago our knowledge of glacial physics was almost entirely derived from European study. However, the glaciers of the Alps gave but small or unsatisfactory help toward the explanation of some of the most important phenomena produced by the continental ice sheets, for example, the general sheet of till, drumlins, and the various aqueo-glacial deposits as eskers, kames, loess. The interpretations were largely inferential. More has been learned of the structure, behavior, and work of our ancient ice sheets by the study of the Alaskan glaciers during the last ten years, and especially by the study of the Greenland ice cap during the last four years, than by all the study of the Alpine glaciers for the seventy years since they have been observed.

The North American continent is recognized as the theater of the greatest display of glacial activity, not in the past only, but also in the present. It must become the Mecca of the foreign glacialist. Though much has been already accomplished, the work in America has only begun, and there is a large opportunity for future investigation.

About 1850 the Agassizian hypothesis became the glacial theory. Now the glacial geologists understand that the glacial genesis of the "drift" is no longer a theory but an established fact. They will do well to cease paying the deference to doubt implied in the word "theory," and abandon its use in connection with the casual relation of the glacial phenomena. The glacial drift is as much a scientific fact as the volcanic

cone of Vesuvius. The latter is seen in process of construction just as striae, moraines, etc., are seen in the process of formation. As well might geologists speak of the oceanic theory with reference to rock strata as longer to speak of the glacial theory with reference to glacial deposits.

THE CULTIVATION OF SAFFRON.

THE cultivation of saffron, which but a few years ago was quite a flourishing industry, is tending to lose its importance. The principal centers of production in France are a portion of the department of Vaucluse, and, in the vicinity of Paris, the districts of Montargis



FIG. 1.—A SAFFRON PLANT AND ITS CORM.

and Pithiviers. Being located in the vicinity of the saffron plantations, I have been able to study this culture in situ, and very often to have a talk with the land owners who exploit it. It is quite easy to verify the fact that saffron is undergoing a commercial depreciation and that the areas planted are constantly diminishing. For several years past, foreign products, especially Spanish and Indian saffron, have been disturbing the French market and doing great damage to our local trade. The orders given to the small cultivators of the vicinity of Montargis are becoming more and more rare, and the output of the product is even getting quite uncertain. The foreign saffron is certainly inferior to ours in quality, and the importation of it can be nothing but prejudicial to the French cultivation. I had an opportunity last year to talk at some length with a saffron grower, and took occasion to ask him his impressions as to the future of the famous tinctorial plant that for a long period was the source of wealth of Gatinais. "What could you expect?" said he. "We are obliged to curtail the extent of our planting on account of the small demand that exists. Formerly, commercial transactions were easy,

ject to the exterior. The flowers reach their full expansion along toward the month of October. Immediately after this, the leaves, which have remained in a rudimentary state, take on their definitive length and cover the ground until the month of April.

The stigmas, therefore, form the essential part of the plant. They contain a volatile oil and a coloring element called polychroite. Under the influence of various chemical products, this coloring matter, which is called also safranin, is capable of assuming dissimilar shades—whence its name of polychroite, or "many colors." Its normal color is yellow, but sulphuric acid causes this to change to blue, and nitric acid to green. On account of its feeble solidity, the coloring principle of saffron is not used for the dyeing of fabrics; yet its peculiar properties cause it to be esteemed for certain other purposes. It is employed for coloring confectionery, butter, liqueurs, and pastry yellow and has received numerous applications in pharmacy and medicine. As a medicinal agent, it is an excitant, stimulant and emmenagogue. As a medicine for women, the stigmas of saffron are commonly used in the dose of eight or ten filaments per tea cup. Finally, it enters into the composition of theriac, elixir of Garris, and Sydenham's laudanum.

The cultivation of the plant is the object of particular care, and is generally concentrated upon limited areas and undertaken by small growers who work at it with their entire family. The saffron plant adapts itself to most climates, and grows as well in Asia as in Europe. In France, it will yield products in the south as well as in the north, provided that it does not have to endure too intense cold. The corms cannot withstand a temperature of from 12° to 15° below zero. The disastrous winters of 1789, 1819, and 1823 destroyed a portion of the saffron fields of Gatinais and the environs of Carpentras. Such want of endurance might be remedied by burying the corms deeper at the moment of planting.

Saffron likes fertile and absolutely clean soil. The method of cultivating it does not permit of making it enter into a regular distribution of crops, since it is necessary to allow seven or eight years to elapse before replanting in the same place. From an agricultural standpoint, it may therefore be likened to an artificial forage of long duration.

The soil has to be always mellowed and prepared by numerous agricultural processes. The treatment to which the plant is submitted prevents it from fructifying, and it is therefore impossible to use seeds for multiplying it. It is necessary to employ commercial corms and to utilize the best-shaped side corms that have been collected at the moment of closing an old saffron field. In this case, the new corms, after being separated from the old, are preserved in strata, either in slightly damp earth or in sand, until they are needed for use.

The planting is done in rows spaced from six to eight inches apart, from the month of June until the end of the month of August. The laborer, with a narrow spade, opens a trench six inches in depth and places the corms regularly in the bottom. The trench is then filled in and the plantation left to itself for some time. At the moment the leaves appear, a light second dressing is given. The operation is completed by other dressings and by weeding done at various times during the growth of the plant.

In Loiret the duration of a saffron field is about three years. The flowers make their appearance in autumn and the crop is gathered uninterruptedly during almost the entire month of October. The collecting is generally done by women, who separate the petals of the flower by pinching the base of the latter between their thumb and forefinger.

Fig. 2, reproduced from a photograph taken upon the territory of Pannes, a village but a few miles distant from Montargis, represents a saffron field in flower. Its reduced proportions show the peculiar character of the industry and its localization in small

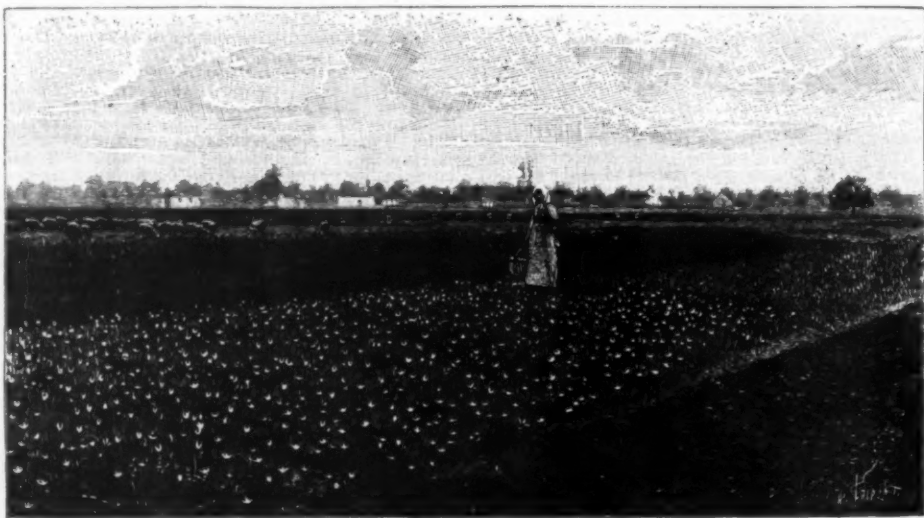


FIG. 2.—A SAFFRON FIELD IN FULL FLOWER.

since commission agents passed through the exploitations and purchased the saffron at remunerative prices. At present we have to look for buyers, and our profits are truly derisory."

Saffron (*Crocus sativus*) is a plant belonging to the order Iridaceae. Its corms are covered with several thin and fibrous tunics, and after they have been planted they soon put forth a sheath of leaves from the center of which eventually rise one or two flowers of a violet color. In the interior of the flower are found the stigmas, which yield the coloring material commonly known as "saffron." Fig. 1, which is an exact reproduction of the appearance of a plant in full blossom, shows the form of the stigmas as they pro-

exploitations. The saffron picker is in the act of gathering the expanded flowers. It is quite easy to follow her work and to see how much field she has yet to go over. After being gathered, the flowers have to be divested of their stigmas. Men and women do this work during the evenings of winter. It is a question of separating the useful part from the rest of the flower. This is done by taking each flower in succession and pinching it at the base of the corolla tube. Under the influence of such pressure, the stigmas soon lose their adhesion and may be extracted with great ease.

The saffron cannot be delivered to the trade until after it has been dried. The processes of desiccation vary with the exploitation and the region. In the

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south of France the product is sometimes exposed to the sun, while in Gatinais recourse is had to artificial heat. One of the processes in quite common use is that which consists in filling a small horse hair sieve with twelve or more ounces of stigmas and exposing it for a few minutes to the heat of a wood or charcoal fire. The operation is a delicate one and requires a certain amount of practice. If it were somewhat prolonged, it would be attended with a discoloration of the product. The shipments are made in bags, cases, kegs, or tin boxes.

During its growth, the saffron has, unfortunately, to undergo the attacks of a large number of animal and vegetable parasites. Among the former may be mentioned rats and field mice, which attack the corms, and hares and rabbits, which eat the leaves just as they are beginning to shoot forth.

The two by far the most to be dreaded affections are rot and a species of fungus. The rot of the corm seems to be due to a wound. Therefore, through precaution and a careful selection at the moment of planting, it would seem possible to limit the extent of this trouble considerably. As for the fungus, that is a parasitic species called *Rhizoctonia violacea*, which has been the terror of cultivators from all times. The corms attacked become covered with a violet, felt-like substance formed by a filamentous mycelium. At the same time, the internal solid part becomes soft and glutinous and soon enters into decomposition. At the end of the last century, Duhamel de Monceau prescribed energetic measures for combating the parasite. Up to then the cultivators had been reduced to forming protective inclosures by digging around the parts affected trenches deep enough to stop the advance of the fungus and limit its action to a certain area.

Not long ago, M. Millet, a cultivator at Juranville, pointed out a method of treatment, but it has not been applied sufficiently on a large scale to allow it to be recommended without reserve. It suffices, it appears, to dissolve sulphate of iron in milk of lime and to dip into this liquid, properly diluted, the corms that are to be used for planting.

The cultivation of saffron might receive some advantageous modifications. According to Messrs. Chapellier & Aneau, it would prove of interest to substitute biennial for triennial cultivation. In this way there would be obtained fine and vigorous corms more resistant to disease and capable of giving a more certain product in the very year that they are planted. At the moment of starting the saffron field it would be necessary, also, in order to guarantee the plant further against the cold of winter, to bury the corms deeper, say seven or eight inches below the surface.—Albert Vilcoq, in *La Nature*.

A HUNTING EXPEDITION IN THE ALTAI MOUNTAINS.

In the summer of 1897, Dr. Von Wissman and his tried companion and friend, Dr. Buniller, set out on a long expedition to the Altai Mountains, on the cold heights of which they hoped to bring down many a wild buck. As might naturally be supposed, scientific observations were also made, for a large part of the region through which the German hunters passed is practically unknown to us.

When they arrived at Omsk, the governor-general very courteously supplied the travelers with passports made out in both the Russian and Khirgizian languages. Then began a long journey up the river Ob to Barnaul, the capital of this Altai region. In its constant changes of scenery and long winding stretches of water the Ob is not unlike the Volga. At Barnaul, the center of the mining and iron industries of Western Siberia, a "tarantass," or Russian traveling wagon, was hired, a vehicle drawn usually by three to twelve horses. Every traveler, as soon as he has escaped from this wagon, has heaved a sigh of relief, for the body of the vehicle rests, not upon springs, but upon three heavy ash wood shafts. When driving over rough roads the jolting of the wagon is intolerable. A traveler at the beginning of his journey, finding that he is not proceeding rapidly enough and attempting to goad on the driver by bribing him, soon gives up his attempt to make a "record," for he finds such an attempt coupled with the acquisition of many black and blue spots. The stations at which the horses are changed are distant from one another 25 miles, a distance covered in a few hours by the small, tough, speedy Siberian horses. When ascending a hill the horses are driven on at a constant gallop, and even when descending a very steep hill, they seldom walk. Although the animals are driven on more by the incessant shouting of the driver, the knout is constantly used and the reins pulled mercilessly. On the whole, the horses are roughly treated; only on the post roads, where the

desire to dismount, his Kalnuuk guide advises him by all means to remain in his saddle, arguing with inconsistent Kalnuuk logic that a man has but two legs and a pony four.

After having arrived at Biysk, on the Bia River, one of the two sources of the Ob, the journey was continued to



A GROUP OF KALMUCKS.

the mountains, the foot of which was reached on August 18. The giant Altai Mountains, densely covered with forests at the steeper portions, and extending far into the Chinese empire, had at last been reached. Birch trees and weeping willows here and there dot the fertile valleys, and on the slopes and crests magnificent larch trees and firs grow. On account of the heavy rainfalls, the mountain roads were almost impassable, but at last Ongodai (Kalnuuk for "Ten Gods") was reached, the last Siberian military post on the road to Kobdo, China. At Ongodai, the travelers became better acquainted with the Kalmucks, and when, on



A KHIRGIZIAN BRIDE.

August 25, the journey was resumed, nine of them were engaged as guides. These black mountain Kalmucks have usually been described as an honest, tractable, courteous, and superstitious race. The German hunters found that the description was accurate enough, but they also found that the Kalnuuk has an unquenchable thirst for brandy. These mountain Kalmucks are excellent hunters, and good horse breeders, but are lacking in all the qualities usually found in a warlike race. Indeed, so feeble is the fighting spirit in them, that long ago they voluntarily surrendered themselves

of ice. While making a detour to a famous ibex hunting ground, the hunters discovered a beautiful sheltered lake at a height of 8,200 feet. Here they camped for the night. Through the Chuja steppe the road led them on to Kaetschagatch, a settlement established by Russian tradesmen, and carrying on a lively traffic with

China. The merchandise, which consists largely of tea, is brought over the frontier by long caravans, consisting of fifteen camels usually harnessed together, one behind the other. In such a caravan the foremost camel is usually provided with a flag, and on the last camel a cowbell is hung. When hunting gazelles, the Kalmucks often encountered the northeastern Khirgizian tribes, whose enormous flocks graze on the Chuja steppe.

The weather had now become exceptionally fine, and, with the exception of a few days, remained so for six weeks. The nights were starry and cold, the days clear and sunny, and rather warm toward noon. Viewed at this height in the clear atmosphere, the sunsets appeared entrancingly beautiful. Slowly sinking behind the snow-clad crests, the golden sun colored the whole sky with the most beautiful tints that eye has ever gazed on. Rock piled upon rock, and crest topped by crest, stood out against that gorgeous rainbow sky and lent to the scene a wild, indescribable beauty rarely seen in other parts of the globe.

Ascending one of the small rivers in the steppe, the travelers came upon the first Khirgizian "aul." They were courteously received by the tribe, and were fortunate enough to obtain a photograph of a Khirgizian bride, and the wife of the chief, the former in full wedding costume. Taken as a whole, the Kirgizians did not impress one so favorably as the Kalmucks. They seemed to be lacking in dignity and modesty.

The hunters now traveled to within one kilometer of the Chinese empire, the border line being marked by huge heaps of argali skulls. This whole region appears to be much frequented by the argali. In Mongolia and in the southern Altai Mountains these large wild sheep are seen only here and there; but at the Dscheeggan Burzari thousands of argali wander through the woods. A better hunting ground could hardly be imagined. Often, when at the outskirts of the forest, 7,500 feet above the level of the sea, the hunters could see far below them the wild argali peacefully grazing in broad open spaces covered with short grass and with shrubs, and interrupted here and there by rough outcrops of rock emerging like islands in a sea of green. By day, these noble animals grazed in the open, and when night came they sought retreats in wind-sheltered places among the rocks. In hunting the argali, the utmost precaution must be taken in stalking, and very often the hunter must climb mountains 10,000 feet in height before he can get a shot at his game. Since the argali in their upward flight always run in single file, and never abreast, the hunter is enabled to pick off his game as soon as he gets in range. For twelve days the German hunters had in vain stalked these wild mountain sheep and at last they came upon several large bucks grazing in the solitary, rocky ravines of Chinese Mongolia, miles away from the principal hunting ground. Overjoyed as they were to have reached their goal, they had not the heart to slaughter the noble animals so ruthlessly as the last expedition had done.



CAMELS LADEN WITH HOUSEHOLD GOODS.

traffic is in the hands of the Russians, do they receive better care. Later the traveling wagons were changed for ponies, little animals, which, like most horses of half wild stock, usually pace, and are particularly good climbers.

Should it appear to a European somewhat dangerous to ride down a steep incline and should he express a

to the autocratic Russian. Tenaciously and faithfully they cling to their customs, manners, and religion. Taken as a whole, this nomadic people, by reason of its remarkable laziness, leads a wretched life.

On August 28 the travelers ascended the Chuja. On the next morning they found their thin summer tent stiffly frozen, and the water covered with an inch

It was only natural that a detour was made into China, for while stalking their game, the hunters had perceived from their elevation of 10,000 feet the valley of the Kobdo River. When they arrived at the Chinese frontier post of Suok, the brave Mongolian warriors leaped up in alarm and ran helplessly hither and thither. Not being provided with passports, the hunt-

ers could not remain longer than twenty-four hours in Chinese dominions.

After having returned to camp, they traveled back to Kaetshagatch and over the snow-clad mountains to the Jassatur, a tributary of the Katunja. Here they hunted the Maral deer, and were fortunate enough to bring down one of these large animals, the beautiful antlers of which they brought with them, the first probably seen in Europe. Descending the Altai Mountains, they again met the Khirgizians, this time leading their flocks to the winter pasturage. When a well-to-do family begins this winter migration, a certain traveling order is usually maintained. The procession is generally headed by a large dog; then follow horses, cows, oxen laden with bags; sheep, goats, and camels, carrying on their backs the household goods. The German hunters were hospitably received by these traveling Khirgizians. Kunyssa was offered them, which in color and taste could not be distinguished from good African millet beer.

As they descended the forest became denser and more beautiful. While on the slopes of the Altai Mountains, the hunters could ascertain their height above the level of the sea, merely by observing what varieties of trees grew about them. For example, at a distance of 6,000 feet from the summit, the pine tree begins to grow; at a distance of 5,250 feet the larch tree makes its appearance; at 4,250 feet fir tree and larch tree grow together, while the pine tree disappears. At a height of 4,250 feet above the level of the sea the snow began to disappear, for it was only the beginning of October. The deeper the travelers descended, the warmer it became; and when at last they reached the valley, they found the season transformed into a fine Indian summer.—Illustrirte Zeitung.

APPARATUS FOR ESTIMATING MARSH GAS AND CARBON DIOXIDE IN PIT GASES.*

THE chemical investigation of the effluent pit gases in the upcast shaft affords important assistance in the regulation of ventilation, the alterations in composition thus detected indicating the extent to which the dangerous gases are removed by the ventilating air admitted to the mine. The actual quantities of such gases—viz., methane and carbon dioxide—present are minute, and for this reason accuracy in their detection is essential. Hence the ordinary forms of technical apparatus for gas analysis are scarcely suited to the work, their accuracy being imperfect to the extent of about 0.1 per cent., a figure representing the total amount of the dangerous gases in some ventilation currents. The volumetric methods, such as that devised by Winkler for methane, and by Hesse for carbon dioxide, are more exact and quick in application; but for practical pit work, where the perfect appointments of a chemical laboratory are more or less lacking, these methods are attended with certain difficulties, chiefly in so far as concerns the preparation, preservation and application of the standardized liquids, oxalic acid, and baryta water. These circumstances, coupled with the expense of chemical balances and other necessary appliances, indicate some modification of the simple volumetric gas-testing apparatus as more appropriate; and the author finds the form illustrated in the accompanying drawings highly suitable for the requirements of practice.

This apparatus is only capable of determining small quantities of the gases in question, and is not intended for use in cases where the proportion of combustible gases gives rise to an explosive mixture. In its own particular province it furnishes results accurate to within 0.01 to 0.02 per cent. without the necessity for careful barometric and thermometric readings. In use the apparatus differs from those in general vogue, in that whereas with the latter variable volumes are measured under constant pressure in suitable graduated tubes, in the present instance the volume is constant while the variations of pressure resulting from the elimination or combustion of the gases are observed by their influence on the height of a column of water contained in a graduated tube. The advantage of this system consists in the employment of graduations in millimeters, an arrangement facilitating the correction of errors due to imperfect calibration and insuring accuracy in reading. Thus, if the gas under examination is initially under atmospheric pressure—equal, in round numbers, to that of a column of water 10,000 mm. high—then a decrease in pressure of one millimeter corresponds to a reduction of 0.01 per cent. in volume; so that the presence of 0.01 per cent. of carbon dioxide is indicated by a reduction of 1 mm. in the pressure, while the combustion and absorption of the same quantity of methane is revealed by a diminution in pressure equal to 3 mm.; consequently sufficient accuracy for practical purposes is attainable without any special complexity in the reading.

The apparatus—which is for the most part inclosed in a glass case, *M*, with double walls for the employment of a water jacket to facilitate the maintenance of a constant temperature—consists of a pipette-shaped vessel, *A*, which, with the correction tube, *C*, is mounted on a frame, *G*, and connected, by means of tubing, with an adjustable water tube, *N*. The vessel, *A*, has a capacity of about 200 c. c. and terminates above in an air-tight tap, *H*, while the lower end tapers off to a cylindrical shape, this portion serving for the reception of the absorbent liquid, and being provided with a mark, *m*, for purposes of measurement. A three-way caoutchouc stopper, *K*, closes the lower end, and through the bores of this stopper project a pair of silver conducting wires attached to a platinum spiral, 0.3 mm. in diameter and 5 or 6 centimeters long, which serves, when raised to incandescence by an electric current, for the combustion of the methane in the gaseous mixture contained in *A*. The silver wires are insulated by a coating of enamel or caoutchouc to a point above the mark, *m*, in order to prevent electrolytic action in the absorbent liquid; and their lower terminals are electrically connected with the line wire terminals, *P*, on the outside of the water-jacket, *M*. In front of the vessel, *A*, is fused a small lateral tube, *E*, wherein the gases are sealed by the pressure water, which, to insure constancy of volume, is, at each reading, adjusted to the level of the mark, *m*, at which point the tube is widened out

into a cylinder 0.8 cm. in internal diameter, so that an error of 0.4 mm. in the adjustment of the water is equivalent to 0.02 cubic centimeter, or 0.01 per cent. of the contents of the tube—that is to say, a difference of 1 mm. in the pressure reading. To facilitate adjustment, the mark, *m*, is drawn all round the tube, and its position is also indicated to the eye of the observer by another mark on the outer surface of the glass case.

The apparatus and case are hinged to enable the vessel to be tilted toward the rear in effecting the absorption of the gas. To prevent the pressure water from entering the gas vessel the tube, *E*, is bent twice below the mark, so as to give it a sloping position; consequently, by allowing the water in *E* to recede from the vertical portion to below the bend, it is restrained from entering the tube when the apparatus is tilted. The correction tube is similar in shape to the vessel, *A*, and has a capacity of about 100 to 130 cubic centi-

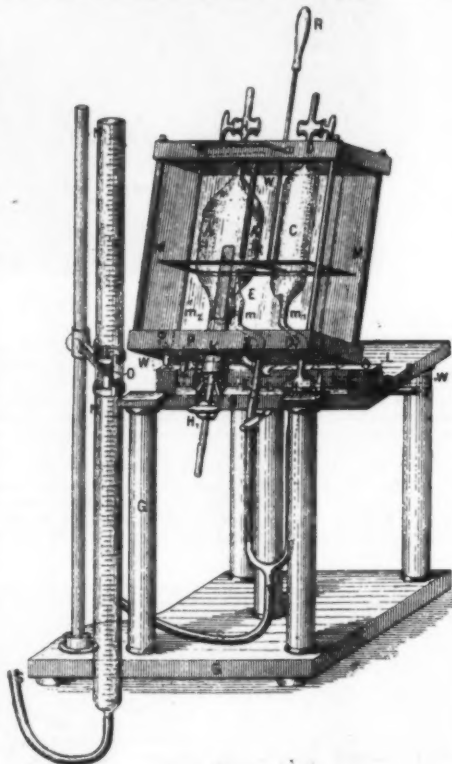


FIG. 1.

ters. It is either fused or else (and preferably) tapped at the upper end, and is contracted below to a diameter of 0.65 to 0.75 cm., a mark, *m*, being made on this portion, which is bent backward below the mark and then back to a vertical position, with the same object as in the case of the tube, *E*. The extreme lower end is closed by a tap, *H*, of wide bore, connected, by tubing, with the adjustable water tube. This correction tube contains air, maintained at constant volume by adjustment to the mark, *m*, at each reading.

The glass case, *M*, is bordered above and below by plates of hard rubber, *D* and *D*₁, attached by clamping screws and making watertight contact with the glass, which is also prevented from shifting laterally by the raised central portion of the plates. The vessels, *A* and *C*, are fixed in position by means of cork or rubber blocks. A stirrer, *R*, is provided to assist in equalizing the internal temperature by keeping the water



FIG. 2.

circulating in the jacket, and a thermometer graduated to $\frac{1}{4}^{\circ}$ or $\frac{1}{2}^{\circ}$ is fitted to the upper plate, *D*, with the same object. In front, the case is supported on two pillars, and is hinged at the back on a bar, *L*, mounted on the front edge of the ledge, *B*, this arrangement enabling the whole to be tilted for the absorption process and restored to the vertical position for reading off the results. The cooling water is admitted to the jacket space through the tube, *Z*, leading to the plate, *D*, and escapes through an opening in the upper plate to which the effluent pipe, *w*, is attached; both these tubes are in such a position as to be unaffected by the tilting of the apparatus.

The lower extremities of the correction tube and the tube, *E*, are connected by caoutchouc tubing and a forked union to the pipe, *S*, attached to the water level vessel (pressure regulator), both tubes and vessel containing the sealing water. By means of the tap, *H*, and the pinch-cock on the tubing below *E*, the re-

spective vessels can be brought into direct connection with the pressure regulator, which is raised or lowered in order to adjust the sealing water to the marks, *m* and *m*₁, and thereby to bring the gas in *A* and the air in the correction tube to the constant volume necessary in reading off the pressure. The adjustment of the water level is effected by either moving the water vessel vertically in front of a graduated scale on a stand or by moving the vessel and attached scale before a fixed mark. The first named condition is fulfilled in the drawing (Fig. 2), the stand being about 11½ meters (60 inches) high with an adjustable slide, *J*, and the attached vessel, *N*. The stand is graduated in centimeters and the slide is guided by a spring fitting into a longitudinal groove. The part, *J*, of the slide can be fixed in position by a clamp, while *J*—which carries the water vessel—can be moved over *J* by means of an adjusting screw, its scale, which is graduated in millimeters, coinciding with the scale on the stand, and indicating the subdivisions of the latter to within a $\frac{1}{2}$ millimeter. The vessel, *N*, is 6 centimeters in diameter, and holds about 200 cubic centimeters. It has a wide neck at the top, and terminates below in a tube for the attachment of the connecting rubber tube, *S*. A second form is also shown in Fig. 1, the vessel, *N*, being in this case formed of a burette about 60 centimeters long, graduated in millimeters, the numbers commencing at the lower end. It is supported by a clamp attached to a stand, and can be raised or lowered with ease, a mark, *O*, on the clamp showing the degree to be read off on the scale. For the absorption of the gas caustic potash is used, being run in from a bulb funnel (not shown), and rubber tube terminating below in a tapered glass tube which is easily inserted in the tube projecting below the tap, *H*.

THE DEVELOPMENT OF PURE FOOD LEGISLATION.*

IT has become customary for the retiring president of the Chemical Society of Washington to present an address on some subject of interest to chemists. If the theme happens to be one which is attracting the attention of thoughtful people generally, it is none the less welcome for that reason. We are American citizens first, then chemists.

For the honor of addressing the Pure Food Congress this evening I am indebted to a happy coincidence in point of time of the meeting of the Chemical Society with the assembly of this congress.

The chosen topic will not, I trust, prove uninteresting to the larger audience, though it was selected and much of the material collected before the call for the present congress was issued. I ask your attention for a short time to a review of legislation concerning food adulteration.

The foods and food stuffs of the most civilized people of early historic times were, as compared with ours, few and simple. They had no market filled with all manner of foods in an advanced state of preparation. The food materials they sold and bought were mainly raw and crude, and their preparation for use was a duty of members or servants of the family. They had neither potted meats nor canned vegetables. When there were "two women grinding at the mill" the meal was made of such grain as the householder furnished. Spices came to them unground and with none of their virtue extracted. The list of fine family groceries was a very short one. Our far-away forbears lived closer to nature and knew less of art than we. Food adulteration as a great evil follows manufactures and commerce and flourishes in the train of a broadening civilization. A disposition to defraud was not wanting to the ancients, but skill to invent and large opportunity to apply are modern.

Early Greece had inspectors of wines to prevent adulteration. Pliny records that in Rome bread was sometimes adulterated with mineral matter, and says that sophistication of wines was prevalent and pure wines difficult to obtain, but it does not appear that corrective legislation was attempted or proposed.

We find sanitary regulations concerning the sale of food, however, among the teachings of Moses in the wilderness and in the Rabbinical laws which were given to the Jews at a very early date. The early Jews, be it remembered, were distinctly a people of this world. They had practically no conception of a future life. Moses scarcely referred to a future existence. His life was devoted to the elevation of his people, and it is not conceivable, with all his versatility and breadth of judgment, that he did not have in mind the sanitary bearing of the laws he gave to his nation. Rather is it probable that he sought to elevate simultaneously the physical, moral, and spiritual natures of his followers. And considering the low state of their civilization, it is suggested by high Jewish authority that he deemed it best to surround his directions with the glamour of mystery and superstition. "Ye shall do no unrighteousness in judgment in meteyard, in weight, or in measure; just balances, just weights, a just ephah, and a just hin shall ye have." This command had reference to commerce in general, but I feel warranted in mentioning it here because similar requirements have commonly been included in pure food laws. It was commanded that the animals which were offered as sacrifices, portions of which were used as food by the priests and Levites, should be without blemish, and that no meat should be eaten more than two days after the slaughter of the animal. It is probable that this was intended to influence the Jewish nation as a whole to eat only fresh meat and that from sound animals. In fact, the Rabbinical law comes to our assistance and requires that all animals used as food by the Jews shall be slaughtered by a priest, who shall carefully examine the lungs and other vital organs to determine if any disease be present, and that no meat shall be eaten more than two days after the slaughter of the animal. It is further provided by both the Biblical and Rabbinical laws that meat shall not be eaten from any animal which died otherwise than at the butcher's hand.

The range of possible adulterations at this time was necessarily very limited and required for its development a corresponding growth of commerce and manufacture.

Passing to the eleventh century, we find the world

* E. Joller. Oesterreichische Zeitschrift für Berg- und Hüttenwesen.—In Colliery Guardian.

* Address of Mr. W. D. Bigelow, the retiring president of the Chemical Society of Washington, delivered before a joint session of the society and the Pure Food Congress, March 2, 1898.

emerging from the Dark Ages. The schoolmen were occupied with metaphysics and theology. Their discussions seem to us unimportant and often trivial, and they were never utilitarian, but they mark an advance toward systematic, scientific thinking. Under their influence new universities were established and those of earlier origin received a fresh impetus. A beginning was made in the literature of the Romance languages, the study of the ancient languages was revived and the Arabian schools of Spain worked over and added to the conglomeration of unclassified theories and facts from which the various departments of science have been developed. Feudalism, whatever its faults, had averted the chaos which for a time threatened to follow the death of Charlemagne and was fostering and augmenting personal honor, the spirit of independence and the love of liberty. Of course, no general laws were possible or necessary at this time, but we find regulations enforced in some cities forbidding the adulteration of wine and beer. Of all foods, these were the most important from a commercial standpoint and were most commonly adulterated. Since then there has never been a time when their adulteration was not restricted by legislation, and each succeeding period increased the list of foods thus protected until the entire field was covered.

With the dawn of the thirteenth century we find eastern Europe greatly advanced in education and civilization. The Crusades have broadened the minds of their participants. Manufactures have become more diversified, commerce has made a corresponding growth, and a spirit of exploration has sprung up, opening new lands to the advancing civilization. In England and in France the common people have been given a voice in the legislative bodies, and it is worthy of note that contemporaneously with this popular quickening and awakening, or as a direct and immediate sequence, the protection of foods was made a subject of frequent legal enactments.

In 1202, thirteen years before the signing of the Magna Charta, the "Assize of Bread" was enacted in England. In 1266, the year following the formation of the House of Commons, a statute was enacted forbidding the sale of unwholesome wine and meat. This law was in force more than four hundred years, when it gave place to a more general law. In 1286 the "Assize of Bread" was repealed by a more comprehensive act known as the "Statute of Assize." This statute was intended to control the size and weight of the loaf, not to prevent adulteration. Its effect was naturally to increase adulteration at first, but additions were made from time to time, as their necessity became apparent, to include all frauds in bread.

During the latter part of this century the adulteration of beer was forbidden in France, and in London it was unlawful to adulterate spices by substitution with foreign matter or inferior goods, or by increasing their weight with water.

In the fourteenth century numerous incidents are recorded of punishment by pillory for short weight and for selling bad bread and putrid meat. Early in the fifteenth century Henry V. issued a proclamation against the adulteration and mixing of wine, prescribing the pillory for offenders. In France it was decreed in 1336 that adulteration and exhausted drugs should not be offered for sale nor used in the preparation of any compounded article. The police departments of French cities adopted food and sanitary regulations, and in 1332 the Provost of Paris declared it illegal for millers to employ cheaper cereals for admixture with their flour, a form of adulteration most difficult to deal with and most dangerous to commerce at the present day. Fourteen years later the artificial coloring of butter was forbidden, as well as the mixture of old butter with new. A few years later it was ordered in Paris that butter should not be sold in the same shop with any article having an offensive odor.

In Germany at this time the food supply was controlled in the various cities by trade organizations, which seem to have had full power to adopt standards, pass judgment, and punish offenders. These guilds, as they were called, existed in a large number of trades and regulated the workmanship of their members as well as the quality of goods sold. The penalties they inflicted were often severe and always humiliating. Among them may be mentioned expulsion from the guild, exposition in the pillory, immersion in muddy water and public whipping. Indeed, instances are recorded in which the offenders were burned at the stake. Finally, a Biebrich dealer was sentenced to drink six quarts of the adulterated wine with which he supplied his customers—an early instance of making the punishment fit the crime.

The fifteenth century brings with it the mariner's compass, the practical application of the art of printing, the organization of banks, important maritime discoveries, and a rapid growth of manufactures and commerce. In this century, however, and in the three succeeding, comparatively little progress was made in pure food legislation, though the practice of adulteration increased with the growth of commerce. From time to time the wine and beer laws were made more stringent. In the sixteenth century censors appointed by the College of Physicians, in England, were empowered to investigate and punish irregularities in the sale of drugs and in the practice of medicine. Clauses prohibiting the sale of adulterated goods were included in the Danish code, and pharmacopoeias were compiled in England and Germany in the seventeenth century, and in the eighteenth century laws were passed in England which had for their purpose the increase of the revenues by means of regulating the adulterations of coffee and tea.

In four centuries, however, no great progress in food legislation was made, nor was it possible till iatrochemistry had ceased to exist, till the phlogiston theory had become a thing of the past, and the balance and the microscope had enabled us to judge of the purity and quality of the food we examine. Before the present century it would have been impossible to enforce a general food law, because of the lack of methods to detect adulterants. A single illustration of the crudeness of the early methods will suffice. In the sixteenth century al-tasters were appointed in England, whose duty it was to examine all ale before it could be sold. They were instructed, among other things, to pour a little of the ale they were examining on a bench and sit on it, and if their leather breeches stuck to the bench, the presence of added sugar was definitely proved.

In 1802 the Conseil de Salubrité was established in Paris, and similar organizations in other cities and some of the provinces soon followed. These committees gave close attention to the question of food adulteration, and the progress made in this direction in the first half of this century was largely due to them. During the same period laws were passed in England relating to the adulteration of several articles of food. The penal codes in the Netherlands and in the Scandinavian peninsula contained clauses regulating the sale of adulterants and damaged goods, which have only been rigidly enforced within the last forty years.

The middle of the present century marked a new and most important era. The methods of quantitative analysis had for the first time been effectively applied to the examination of foods. The microscopist had made great progress in his field, and more than a beginning had been made in the study of vegetable histology. Adulterants which might and did pass without suspicion twenty or ten years earlier were then detected with certainty, and the analyst could follow the manufacturer and discover each new cheat as it took the place of an old one which had been exposed. It must not be supposed, however, that all abuses were immediately corrected, or even that the progress of reform was easy and rapid.

In England advocates of a general and efficient food adulteration law were not wanting, but the people at large were apathetic and Parliament was more concerned with party questions than with measures that, while promising little party advantage, were threatened with strong opposition. Trained analysts were few and far between, and, in the absence of standards, there was no end of conflict and jealousy among the few experts.

The London Lancet has earned the gratitude of the civilized world by its early, earnest, fearless, persistent, and finally successful advocacy of food adulteration laws. It was in a position of commanding influence and it stood for public welfare. The Lancet's Analytical Sanitary Commission, established in 1850, with Dr. Arthur Hill Hassell as chief analyst, waged a determined warfare on food and drug adulteration for a period of nearly twenty years; in fact, until comprehensive laws had been enacted and their efficiency demonstrated. The Analytical Sanitary Commission made reports from time to time of the analyses of a large number of foods, drinks, drugs, confections, tobacco, etc., it being the first to undertake this work in any systematic way. Naturally, opposition in every form was excited and became active, vigorous, and determined. The commission and the editor of The Lancet were threatened with legal prosecution and personal violence. In the House of Commons Sir Charles Wood, Chancellor of the Exchequer, quoted as the opinion of the "most distinguished chemist of the day" the assertion that "neither by chemistry nor by any other means" could the admixture of chicory with coffee be detected, the falsity of which assertion Dr. Hassell demonstrated with the microscope. The protection of coffee from adulteration by chicory, which itself had been adulterated with parsnips and other roots, was the first practical achievement of the commission, although the question of coffee adulteration and the scale of coffee substitutes was considered from the standpoint of revenue rather than of fraud.

In 1854 Dr. Hassell published "Food and its Adulterations—comprising the Reports of the Analytical Sanitary Commission of The Lancet for the years 1851 to 1854 inclusive." Before the publication of these reports in The Lancet it was notorious that many articles of food were generally adulterated, but nothing was known with the precision necessary to suppress fraud. Conclusive evidence of the value of the commission's revelations, which had a wide circulation in Dr. Hassell's book, is found in the fact that reforms in food laws were immediately pressed in Parliament.

Nor was the movement confined to England. In 1855 the French law relative to foods, which had been in force since 1851, was amended to include drinks, and progress was made in Spain, Denmark, and other countries. In the same year the Select Committee on the Adulteration of Food was appointed by Parliament and began an investigation, summoning before it a large number of witnesses, embracing chemists, microscopists, manufacturers, wholesale dealers, and consumers, but no general law was passed until 1860. In the same year, 1859, Dr. Letheby was appointed medical officer for the City of London, a position which had been sought with much earnestness by Dr. Hassell, both of whom had been prominent in the agitation for pure food laws.

A work "On the Composition of Food, and how it is Adulterated, with Practical Directions for its Analysis," by W. Marcet, M.D., F.C.S., etc., appeared in 1856. Dr. Marcet devotes a considerable space to disparaging the work done by Dr. Hassell, and The Lancet reviews Marcet's book with marked severity.

Jealousies among the advocates of reform in food laws are noticeable in all the discussions of this period, and doubtless they had no small effect in delaying the passage of an efficient food law. At the least they furnished weapons for an open opposition which drew its inspiration from the profits of adulteration.

In 1857 Dr. Hassell published a second book entitled "Adulterations Detected; or Plain Instructions for the Discovery of Frauds in Food and Medicine."

During this period of discussion and waiting in England the French were dealing with offenders under their national and municipal laws forbidding the preparation and sale of adulterated articles of merchandise and the use of incorrect weights and measures. The penalties under these laws were publication, fine, and imprisonment. Dealers convicted under municipal laws were compelled to post conspicuously in their places of business large placards with a confession, in detail, of their guilt.

In 1860 Parliament passed the "Adulteration of Food and Drugs Act," which made it illegal, first to sell any article of food or drink with which, to the knowledge of the seller, any article or ingredient injurious to health had been mixed; second, to sell as pure or unadulterated any article of food which was adulterated or not pure. The appointment of analysts was optional with boards of health, church vestry, and other bodies. The prescribed fees, ranging from a half crown to ten shillings, were hardly sufficient to pay the cost of materials required for the analysis.

The law was a beginning, but scarcely more. The

failure to establish standards and provide for the certain appointment of inspectors and analysts, and the provision making proof of "guilty knowledge" necessary to conviction, insured the failure of the law as a practical measure. Indeed, these defects were plainly and persistently pointed out before the passage of the act, and it is difficult to escape the conclusion that among those who voted for its passage were some who knew how to "run with the hare and hold with the hound." With only a few trained analysts, each of them jealous of the others, and with no recognized standards, it seems the time had not come for a more efficient food law in England than that of 1860.

The agitation was continued, and in 1872 the Act of 1860 was re-enforced by the "Act for the Prevention of the Adulteration of Food and Drinks and of Drugs" (35 and 36 Vic. C. 74). This act provided for the appointment of inspectors, did not require the proof of "guilty knowledge" for conviction under the charge of selling adulterated foods, and was applicable to drugs as well as foods. In correcting one of the flaws in the Act of 1860 by not requiring the proof of "guilty knowledge," a serious mistake was made in affording no protection to retail dealers, and much injustice resulted.

The dissatisfaction produced by the shortcomings of this act were called to the attention of Parliament by numerous petitions from all the larger cities. The result was the appointment, in 1874, of a second Select Committee, which advised that the act be amended. The committee also expressed the opinion that much of the injustice complained of was due, not to the act itself, but "to the want of a clear understanding as to what does, and what does not, constitute adulteration, and in some cases to the conflicting decisions and inexperience of the analysts."

As the result of the investigation and report of the Select Committee, legislation was again attempted the following year.

"An Act to repeal the Adulteration of Food Acts and to make better provision for the sale of Food and Drugs in a pure state" (38 and 39 Vic. C. 63, August 11, 1875).

Sec. 1. Repeals former statutes.
Sec. 2. The term "food" is defined as including every article used for food or drink by man other than drugs and water. The term "drug" includes all medicines for internal or external use.

Sec. 3. "No person shall mix, color, stain, or powder . . . any article of food with any ingredient or material so as to render the article injurious to health, with intent that the same may be sold in that state, and no person shall sell any such article so mixed, colored, stained, or powdered, under a penalty in each case not exceeding fifty pounds for the first offense; every offense, after a conviction for a first offense, shall be a misdemeanor, for which the person, on conviction, shall be imprisoned for a period not exceeding six months with hard labor."

Sec. 4. Prohibits the mixing of drugs with injurious ingredients and the selling of the same.

Sec. 5. Exempts in case of proof or absence of knowledge, and of ability "with reasonable diligence to obtain that knowledge."

Sec. 6. "No person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance, and quality of the article demanded by such purchaser."

Sec. 7. Provides for the sale of compound articles of food and compound drugs.

Sec. 8. Provides that the fixing of a legible label, stating that the goods are mixed, shall be a sufficient protection against conviction by this act.

Sec. 9. Prohibits the abstraction of any part of an article of food with intent to sell without notice of such abstraction, and the selling of such article without notice.

I refer to only a few of the sections of this law. As a whole it was far better than any legislation that had preceded it in England or in any other country, yet owing to the peculiar constructions placed upon it by the magistrates, convictions, even in cases of evident violation of the act, were difficult and often impossible to secure.

A clear idea of the chief legal difficulties which confronted those charged with enforcing the Sale of Food and Drugs Act can be given by quoting from "An Act to Amend the Sale of Food and Drugs Act" (42 and 43 Vic. C. 30, 1879):

Sec. 2. "In any prosecution under the provision of the principal act for selling to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance, and quality of the article demanded by such purchaser, it shall be no defense to any such prosecution to allege that the purchaser, having bought only for analysis, was not prejudiced by such sale. Neither shall it be a good defense to prove that the article of food or drug in question, though defective in nature or in substance or in quality, was not defective in all three respects."

Sec. 6. "In determining whether an offense has been committed under section 6 of said act by selling, to the prejudice of the purchaser, spirits not adulterated otherwise than by the admixture of water, it shall be a good defense to prove that such admixture has not reduced the spirit more than twenty-five degrees under proof for brandy, whisky, or rum, or thirty-five degrees under proof for gin."

A few special acts have since been passed from time to time, but their importance is relatively insignificant. The act of 1875, as amended in 1879, constitutes in greater part the food law of England as existing at the present time.

The enforcement of these acts at first was difficult and uncertain. As has been previously stated, experienced analysts were few, and the remuneration offered was not sufficient to induce reliable and competent men to undertake the work. More than this, conflicting decisions by the magistrates before whom the cases were tried added to the difficulties of enforcing the acts. The word "adulteration" itself received various definitions at the hands of those charged with enforcing the law.

As the intention of the law became more generally understood, standards in all classes of foods were adopted. Legal questions were settled and the machinery for enforcing the acts reduced to working order. In consequence, there has been a constant improvement in the quality of food in the English market,

until at the present time there is no government which more completely protects its people from adulterations in food.

So much attention has been given to English law because of the important effect it had in influencing the legislation of other countries. An example of a good working law was offered, a law which had not only outlived the jealousies and misunderstanding of the friends of reform, but had overcome the most skillful, determined, and persistent opposition of its foes. In the framing of all subsequent laws in other countries the English law has been carefully studied, and the experience gained in the thirty years' contest between the friends and foes of pure food legislation has saved much loss of time and mispent effort.

The machinery for enforcing the law must necessarily vary with the form of government. Sometimes standards have been included in the laws, again other provisions have been made for the adoption of standards.

Since 1880 governmental supervision of the food supply has become general among the nations of the world. In some countries we find scarcely any article of food left unprotected by general enactment. In others the laws are less comprehensive. Where modern civilization is just superseding the ancient order the laws are confined to city ordinances, while in outlying districts where only simple foods are used there is no occasion for restriction.

It is my conviction that in centralized governments the state of a nation's civilization may be judged with accuracy by the protection it affords its people in the quality of the food sold. The absence of national food laws hitherto in the United States may not be well understood in other countries, but it is plain to all who understand the limitations of our federal government. Municipal and State laws, in some cases models of their kind, we have; but the necessity of a national law, covering the whole question in its relation to manufacture and commerce in the District of Columbia and the Territories, the commerce between the States and between the States and the District of Columbia and the Territories, and to our foreign commerce, is becoming apparent to all thinking men. By no other means can we hope to secure laws uniform in their scope, requirements, and penalties among ourselves, and for our foreign commerce nothing less can avail.

We have come upon an era of intense competition and consequent small profits in manufacturing. It often happens that the success, even the life, of an honest business depends on protection from the competition of debased or otherwise fraudulent products. Without protection it becomes a question with the manufacturer whether he shall give up his business or his integrity. Never before did the adulteration of food present so strong temptations to the manufacturer. It is true, indeed, that the fraudulent manufacturer often employs his chemist to help him perpetrate and conceal fraud, and thus adulteration has become a fine art. But there are always honest manufacturers and dealers ready to come to the aid of the health officer. Never before was protection so sure. We can almost say that if any food adulterant runs more than a short course now, the fault must be charged to inefficient food laws.

Let us protect the honest manufacturer and dealer at every point against the unfair competition of dishonest rivals. Let our products stand on their own merits—stand or fall. And let the same rule apply to imported goods.

I have tried to obtain refined cottonseed oil from our leading grocers, but have rarely succeeded except at four times its value and under another name. Our native wines, superior to the common wines of any other country, are creating for themselves an increasing demand in foreign countries under their proper labels. Why, then, should we allow them to receive flimsy names at home? Let us by all proper means promote the use of American maize at home and abroad, but always as maize—not as wheat! Let us eat plain American herrings, if we choose, but not "French sardines" from the coast of Maine. Let us stop the sale of "pure imported Lucca oil" from the cotton fields of Georgia. Whether as a matter of morals or from policy, let us have honesty.

A great deal has lately been heard of small-caliber rifles which will not kill or seriously disable, and we have ourselves had doubts as to their sufficient effect in stopping rushes of Indian frontier men. Lately Major Toutée, of the French army, in a volume entitled "Dahomé, Niger, Touareg," has expressed, as his experience of recent French operations in Africa, the view that the small-caliber arm does not stop the man. He records that 200 rounds fired by the Dahomey troops put more men hors de combat than 3,500 rounds with the new arm. Although the latter, he says, may wound the man, perhaps mortally, he is often able to fight on for a time. The same subject has recently been treated by Lieut.-Colonel Mariani, of the Italian artillery, in the Rivista di Artiglieria e Genio, who expresses rather different views. In the fighting with Menelik, in 1896, the Italians did not employ the new 6.5 mm. rifle, so that nothing can be deduced from the operations, but having regard to the fact that the Chitralis were defeated by the Lee-Metford, the Chinese by the Murata, and the Balmacedists by the small-caliber Mannlicher, Colonel Mariani concludes that the new weapons are better than the old. He thinks, however, that in the 6.5 mm. (0.256 inch) rifle, Italy has adopted the smallest caliber consistent with sufficiently effective result. With a range of 600 meters and a supply of 163 cartridges per man, it will be well, he says, to be content.—Army and Navy Gazette.

A new volume of the Amateur Photographer Library, entitled "Architectural Photography," has appeared from the practiced hand of Mr. G. A. T. Middleton. It is written with his usual conscientiousness and knowledge of his subject. Although it costs only a small sum, it contains a great many illustrations. There is no attempt to write the history of architecture. What Mr. Middleton does mainly is to suggest how the most expressive photographs of buildings are obtainable. That has an advantage for photographers, whether professional or amateur, but a great many of the suggestions can also be utilized by architectural students when on sketching tours.

Recent Books.

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